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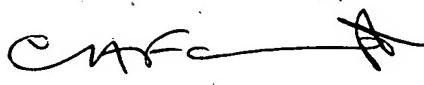
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Dated

29 August 2000

Patents Act 1977  
(Rule 16)The  
Patent  
Office06 SEP 99 E47433 -1 001030  
P01/7700 0.00 9920872.0

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## Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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Cardiff Road  
Newport  
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1. Your Reference

HKQ/PU3517

9920872.0

2. Patent application number

(The Patent office will fill in this part)

3. Full name, address and postcode of the or of each applicant (underline all surnames)GLAXO GROUP LTD  
GLAXO WELLCOME HOUSE  
BERKELEY AVENUE  
GREENFORD  
MIDDLESEX  
UB6 0NN, G

Patents ADP number (if you know it)

473587002

If the applicant is a corporate body, give the country/state of its corporation

4 Title of the invention

BENZOPHENONES AS INHIBITORS OF REVERSE TRANSCRIPTASE

5 Name of your agent (if you know one)

HELEN K. QUILLIN  
(SEE CONTINUATION SHEET)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

GLAXO WELLCOME PLC  
GLAXO WELLCOME HOUSE, BERKELEY AVENUE  
GREENFORD, MIDDLESEX  
UB6 0NN, GB

Patents ADP number (if you know it)

64705791001

6. If you are declaring priority from one or more earlier patent applications, give the country and date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country      Priority application number  
(if you know it)      Date of Filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant a patent required in support of this request? (Answer yes if:

YES

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

## BENZOPHENONES AS INHIBITORS OF REVERSE TRANSCRIPTASE

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### Background of the Invention

The human immunodeficiency virus ("HIV") is the causative agent for acquired immunodeficiency syndrome ("AIDS"), a disease characterized by the destruction of the immune system, particularly of CD4<sup>+</sup> T-cells, with attendant susceptibility to opportunistic infections, and its precursor AIDS-related complex ("ARC"), a syndrome characterized by symptoms such as persistent generalized lymphadenopathy, fever and weight loss. HIV is a retrovirus; the conversion of its RNA to DNA is accomplished through the action of the enzyme reverse transcriptase. Compounds that inhibit the function of reverse transcriptase inhibit replication of HIV in infected cells. Such compounds are useful in the prevention or treatment of HIV infection in humans.

Non-nucleoside reverse transcriptase inhibitors (NNRTIs), in addition to the nucleoside reverse transcriptase inhibitors gained a definitive place in the treatment of HIV-1 infections. The NNRTIs interact with a specific site of HIV-1 reverse transcriptase that is closely associated with, but distinct from, the NRTI binding site. NNRTIs, however, are notorious for rapidly eliciting resistance due to mutations of the amino acids surrounding the NNRTI-binding site (E. De Clercq, *Il Farmaco* 54, 26-45, 1999). Failure of long-term efficacy of NNRTIs is often associated with the emergence of drug-resistant virus strains (J. Balzarini, *Biochemical Pharmacology*, Vol 58, 1-27, 1999). Moreover, the mutations that appear in the reverse transcriptase enzyme frequently result in a decreased sensitivity to other reverse transcriptase inhibitors, which results in cross-resistance.

JP 59181246 disclosed certain benzophenones useful as anticancer agents. Certain benzophenone derivatives as inhibitors of HIV-1 reverse transcriptase were disclosed in Wyatt et al. (J. Med. Chem. 38:1657-1665, 1995). However, these compounds were primarily active against wild-type HIV-1 reverse transcriptase, rapidly induced resistant virus, and were inactive against a common resistant strain.

We have now discovered that the compounds of the present invention are useful as inhibitors of both wild type and mutant variants of HIV reverse transcriptase.

R<sup>1</sup> is C<sub>1-8</sub>alkyl; C<sub>3-6</sub>cycloalkyl; C<sub>6-14</sub>aryl which may be optionally substituted with one or more substituents selected from the group consisting of halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylamino, C<sub>3-6</sub>cycloalkylC<sub>2-6</sub>alkenyl, C<sub>6-14</sub>arylC<sub>2-6</sub>alkenyl, -CN, -NO<sub>2</sub>, -NH<sub>2</sub>, -SR<sup>6</sup>, -S(O)<sub>2</sub>R<sup>6</sup>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, C<sub>2-6</sub>alkenyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, and heterocycle, and C<sub>2-6</sub>alkynyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl, and heterocycle; or heterocycle, optionally substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -CN, C<sub>6-14</sub>arylC<sub>1-8</sub>alkyl and heterocycle;

10 R<sup>6</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, aryl, and heterocycle;

15 R<sup>7</sup> is C<sub>1-8</sub> alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl and heterocycle; -NH<sub>2</sub>; or heterocycle;

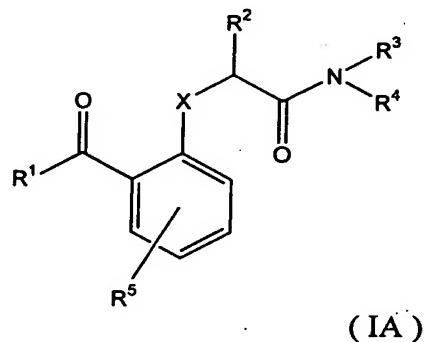
R<sup>2</sup> is hydrogen; halogen; or C<sub>1-8</sub>alkyl;

20 R<sup>3</sup> and R<sup>4</sup> are independently hydrogen; hydroxy; heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, hydroxy, hydroxyC<sub>1-8</sub>alkyl, halogen, C<sub>1-8</sub>alkyl, OR<sup>11</sup> and -SR<sup>10</sup>N(R<sup>10</sup>)<sub>2</sub>; or C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, hydroxyC<sub>1-8</sub>alkyl, -CN, -NO<sub>2</sub>, C<sub>1-8</sub>alkylamino, heterocycleC<sub>1-8</sub>alkyl, -C(O)NH<sub>2</sub>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, -NS(O)<sub>2</sub>R<sup>7</sup>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, -C(O)R<sup>11</sup>, -C(O)NR<sup>11</sup>, -C(O)OR<sup>11</sup>, -NR<sup>11</sup>, -NC(O)R<sup>11</sup>, heterocycleC<sub>2-6</sub>alkenyl, heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo, C<sub>1-8</sub>alkyl, and C(O)OR<sup>11</sup>, and C<sub>1-8</sub>alkyl which may be optionally substituted with one or more substituents selected from the group consisting of -CN and heterocycle, optionally substituted with -C(O)R<sup>11</sup>; provided that R<sup>3</sup> and R<sup>4</sup> cannot both be hydrogen or hydroxy;

25 R<sup>8</sup> and R<sup>9</sup> are independently selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylamino, C<sub>1-8</sub>alkylheterocycle, heterocycle, and C<sub>3-6</sub>cycloalkyl;

30 R<sup>10</sup> is C<sub>1-8</sub>alkyl;

In another aspect of the present invention compounds of formula (IA) are disclosed:



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wherein:

X is C, O, or N;

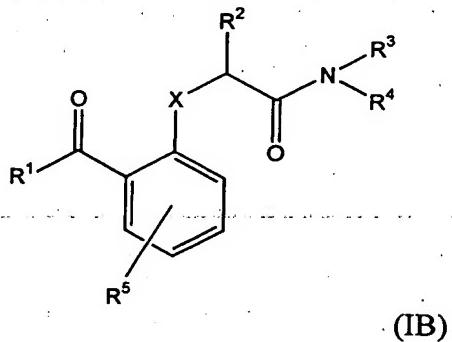
10      R¹ is C<sub>6</sub>-14aryl which may be optionally substituted with one or more substituents selected from the group consisting of halogen, -CF<sub>3</sub>, C<sub>1</sub>-8alkyl, C<sub>1</sub>-8alkylamino, C<sub>3</sub>-6cycloalkylC<sub>2</sub>-6alkenyl, C<sub>6</sub>-14arylC<sub>2</sub>-6alkenyl, -CN, -NO<sub>2</sub>, -NH<sub>2</sub>, -SR<sup>6</sup>, -S(O)<sub>2</sub>R<sup>6</sup>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, C<sub>2</sub>-6alkenyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, and heterocycle and C<sub>2</sub>-6alkynyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, C<sub>3</sub>-6cycloalkyl, and heterocycle;

15      R<sup>6</sup> is C<sub>1</sub>-8alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxyl, halogen, -CF<sub>3</sub>, aryl, and heterocycle;

20      R<sup>7</sup> is C<sub>1</sub>-8 alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, aryl, C<sub>3</sub>-6cycloalkyl and heterocycle; -NH<sub>2</sub>; or heterocycle;

25      R<sup>2</sup> is hydrogen; halogen; or C<sub>1</sub>-8alkyl;

R<sup>3</sup> is hydrogen;



5 wherein:

X is C, O, or N;

10  $R^1$  is  $C_{6-14}$ aryl substituted with one or more substituents selected from the group consisting of halogen,  $-CF_3$ ,  $C_{1-8}$ alkyl,  $C_{1-8}$ alkylamino,  $C_{3-6}$ cycloalkyl $C_{2-6}$ alkenyl,  $C_{6-14}$ aryl $C_{2-6}$ alkenyl,  $-CN$ ,  $-NO_2$ ,  $-NH_2$ ,  $-SR^6$ ,  $-S(O)_2R^6$ ,  $-S(O)R^7$ ,  $-S(O)_2R^7$ ,  $-C(O)R^7$ ,  $C_{2-6}$ alkenyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, and heterocycle, and  $C_{2-6}$ alkynyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl,  $C_{3-6}$ cycloalkyl, and heterocycle;

15  $R^6$  is  $C_{1-8}$ alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxyl, halogen,  $-CF_3$ , aryl, and heterocycle;

20  $R^7$  is  $C_{1-8}$  alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxyl, halogen, aryl,  $C_{3-6}$ cycloalkyl and heterocycle;  $-NH_2$ ; or heterocycle;

$R^2$  is hydrogen; halogen; or  $C_{1-8}$ alkyl;

$R^3$  is hydrogen;

25  $R^4$  is heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, hydroxy, hydroxy $C_{1-8}$ alkyl, halogen,  $C_{1-8}$ alkyl,  $-OR^{11}$  and  $-SR^{10}N(R^{10})_2$ ;

$R^{10}$  is  $C_{1-8}$ alkyl;

R<sup>4</sup> C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, hydroxyC<sub>1-8</sub>alkyl, -CN, -NO<sub>2</sub>, C<sub>1-8</sub>alkylamino, heterocycleC<sub>1-8</sub>alkyl, -C(O)NH<sub>2</sub>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, -NS(O)<sub>2</sub>R<sup>7</sup>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, -C(O)R<sup>11</sup>, -C(O)NR<sup>11</sup>, -C(O)OR<sup>11</sup>, -NR<sup>11</sup>, -NC(O)R<sup>11</sup>, heterocycleC<sub>2-6</sub>alkenyl, heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo, C<sub>1-8</sub>alkyl, and -C(O)OR<sup>11</sup>, and C<sub>1-8</sub>alkyl which may be optionally substituted with one or more substituents selected from the group consisting of -CN and heterocycle, optionally substituted with -C(O)R<sup>11</sup>;

10 R<sup>7</sup> is C<sub>1-8</sub> alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl and heterocycle; -NH<sub>2</sub>; or heterocycle;

15 R<sup>8</sup> and R<sup>9</sup> are the same or different and are selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylamino, C<sub>1-8</sub>alkylheterocycle, heterocycle, and C<sub>3-6</sub>cycloalkyl;

20 R<sup>11</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -NR<sup>8</sup>R<sup>9</sup>, and heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo and C<sub>1-8</sub>alkyl;

25 R<sup>5</sup> is hydrogen; halogen; C<sub>1-8</sub>alkyl; -NO<sub>2</sub>; -NH<sub>2</sub>; C<sub>1-8</sub>alkylamino; CF<sub>3</sub>, or alkoxy;

or a pharmaceutically acceptable derivative thereof.

25 Preferred compounds of formula (IC) are those wherein X is O.

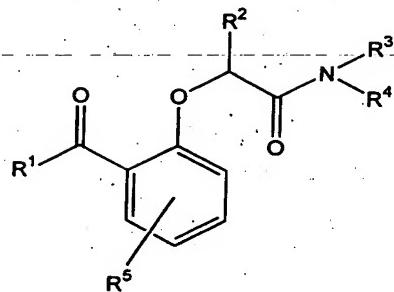
More preferred compounds of formula (IC) are those wherein X is O; R<sup>1</sup> is heterocycle, optionally substituted with -CN; R<sup>2</sup> and R<sup>3</sup> are hydrogen; R<sup>4</sup> is C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, and heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo; and R<sup>5</sup> is halogen.

or a pharmaceutically acceptable derivative thereof.

Preferred compounds of formula (I) are those wherein X is O.

More preferred compounds of formula (I) are those wherein X is O; R<sup>1</sup> is heterocycle; R<sup>2</sup> and R<sup>3</sup> are hydrogen; R<sup>4</sup> is heterocycle; and R<sup>5</sup> is halogen.

In a further aspect of the present invention there is provided compounds of formula  
10 (II):



(II)

15

wherein:

R<sup>1</sup> is C<sub>6-14</sub>aryl which may be optionally substituted with one or more substituents selected  
0 from the group consisting of halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylamino, C<sub>3-6</sub>cycloalkylC<sub>2-6</sub>alkenyl, C<sub>6-14</sub>arylC<sub>2-6</sub>alkenyl, -CN, -NO<sub>2</sub>, -NH<sub>2</sub>, -SR<sup>6</sup>, -S(O)<sub>2</sub>R<sup>6</sup>,  
-S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, C<sub>2-6</sub>alkenyl which may be optionally substituted with a  
substituent selected from the group consisting of hydroxy, halogen, aryl, and  
heterocycle, and C<sub>2-6</sub>alkynyl which may be optionally substituted with a substituent  
selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl, and  
heterocycle;

R<sup>6</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from  
the group consisting of hydroxy, halogen, -CF<sub>3</sub>, aryl, and heterocycle;

-S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, C<sub>2-6</sub>alkenyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, and heterocycle, and C<sub>2-6</sub>alkynyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl, and heterocycle; or heterocycle, optionally substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -CN, C<sub>6-14</sub>arylC<sub>1-8</sub>alkyl and heterocycle;

5 R<sup>6</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, aryl, and heterocycle;

10 R<sup>7</sup> is C<sub>1-8</sub> alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl and heterocycle; -NH<sub>2</sub>; or heterocycle;

15 R<sup>4</sup> is heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, hydroxy, hydroxyC<sub>1-8</sub>alkyl, halogen, C<sub>1-8</sub>alkyl, -OR<sup>11</sup> and -SR<sup>10</sup>N(R<sup>10</sup>)<sub>2</sub>; or C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, hydroxyC<sub>1-8</sub>alkyl, -CN, -NO<sub>2</sub>, C<sub>1-8</sub>alkylamino, heterocycleC<sub>1-8</sub>alkyl, -C(O)NH<sub>2</sub>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, -NS(O)<sub>2</sub>R<sup>7</sup>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, -C(O)R<sup>11</sup>, -C(O)NR<sup>11</sup>, -C(O)OR<sup>11</sup>, -NR<sup>11</sup>, -NC(O)R<sup>11</sup>, heterocycleC<sub>2-6</sub>alkenyl, heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo, C<sub>1-8</sub>alkyl, and -C(O)OR<sup>11</sup>, and C<sub>1-8</sub>alkyl which may be optionally substituted with one or more substituents selected from the group consisting of -CN and heterocycle, optionally substituted with -C(O)R<sup>11</sup>;

20 25 R<sup>8</sup>and R<sup>9</sup> are the same or different and are selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub> alkylamino, C<sub>1-8</sub>alkylheterocycle, heterocycle, and C<sub>3-6</sub>cycloalkyl;

R<sup>10</sup> is C<sub>1-8</sub>alkyl;

30 R<sup>11</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, -SO<sub>2</sub>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -NR<sup>8</sup>R<sup>9</sup> and heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo and C<sub>1-8</sub>alkyl;

Preferred compounds of the present invention include:

- 5 2-[2-(1-benzothiophen-2-ylcarbonyl)-4-chlorophenoxy]-N-phenylacetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1H-imidazol-1-yl)phenyl]acetamide;  
10 2-[4-chloro-2-(2-thienylcarbonyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1H-1,2,4-triazol-1-yl)phenyl]acetamide;  
15 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(4-morpholinyl)phenyl]acetamide;  
N-[4-(aminosulfonyl)phenyl]-2-(2-benzoyl-4-chlorophenoxy)acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-{4-[(1,3-thiazol-2-ylamino)sulfonyl]phenyl}acetamide;  
20 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(4-methyl-1-piperazinyl)phenyl]acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[4-(hydroxymethyl)phenyl]acetamide;  
25 2-(2-benzoyl-4-chlorophenoxy)-N-{4-[(methylamino)sulfonyl]phenyl}acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;  
30 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1,1-dioxo-1lambda~6~,4-thiazinan-4-yl)phenyl]acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[2-methyl-4-(4-morpholinyl)phenyl]acetamide;  
35 2-(2-benzoyl-4-chlorophenoxy)-N-{4-[3-(dimethylamino)propoxy]-2-methylphenyl}acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1-hydroxyethyl)phenyl]acetamide;  
40 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1-hydroxyethyl)phenyl]acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;  
45 2-(2-benzoyl-4-chlorophenoxy)-N-{2-methyl-4-[3-(1-pyrrolidinyl)propoxy]phenyl}acetamide;  
2-(2-benzoyl-4-chlorophenoxy)-N-(1H-indazol-5-yl)acetamide;

- 2-(4-chloro-2-{[5-(2-pyridinyl)-2-thienyl]carbonyl}phenoxy)-N-phenylacetamide;
- 2-[4-chloro-2-(1,3-thiazol-2-ylcarbonyl)phenoxy]-N-(1H-indazol-5-yl)acetamide;
- 2-[4-chloro-2-(1,3-thiazol-2-ylcarbonyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-[4-chloro-2-(3-pyridinylcarbonyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-[2-(2-bromobenzoyl)-4-chlorophenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-[2-(4-bromobenzoyl)-4-chlorophenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[2-(2-bromobenzoyl)-4-chlorophenoxy]acetamide;
- 2-{4-chloro-2-[(5-methyl-3-isoxazolyl)carbonyl]phenoxy}-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-[4-chloro-2-(3-fluorobenzoyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-[4-chloro-2-(3-chlorobenzoyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-fluorobenzoyl)phenoxy]acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-chlorobenzoyl)phenoxy]acetamide;
- 2-{4-chloro-2-[(4-cyano-2-thienyl)carbonyl]phenoxy}-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-{4-chloro-2-[(4-cyano-2-thienyl)carbonyl]phenoxy}acetamide;

- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3,5-dichlorobenzoyl)phenoxy]acetamide;
- 5 N-[4-(aminosulfonyl)-2-methylphenyl]-2-{4-chloro-2-[3-fluoro-5-(trifluoromethyl)benzoyl]phenoxy}acetamide;
- N-(1,3-benzothiazol-6-yl)-2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]acetamide
- 10 2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]-N-(2-methyl-1,3-benzothiazol-5-yl)acetamide
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-(4-chloro-2-{3-[(trifluoromethyl)sulfanyl]benzoyl}phenoxy)acetamide;
- 15 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-ethynylbenzoyl)phenoxy]acetamide;
- 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(methylsulfonyl)phenyl]acetamide;
- 20 N-[4-(aminosulfonyl)-2-methylphenyl]-2-{4-chloro-2-[3-(2-cyclopentylethynyl)benzoyl]phenoxy}acetamide;
- 2-{4-chloro-2-[3-fluoro-5-(trifluoromethyl)benzoyl]phenoxy}-N-(5-methyl-1H-indazol-6-yl)acetamide;
- 25 2-[4-chloro-2-(3,5-dichlorobenzoyl)phenoxy]-N-(5-methyl-1H-indazol-6-yl)acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-{4-chloro-2-[3-(2-phenylethynyl)benzoyl]phenoxy}acetamide;
- 30 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-(5-methyl-1H-indazol-6-yl)acetamide;
- 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-[2-methyl-4-(methylsulfonyl)phenyl]acetamide;
- 35 N-(1,2-benzisothiazol-5-yl)-2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]acetamide;
- 2-[4-chloro-2-(3,5-dichlorobenzoyl)phenoxy]-N-(5-methyl-1H-benzimidazol-6-yl)acetamide;
- 40 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-(5-methyl-1H-benzimidazol-6-yl)acetamide;
- 2-{4-chloro-2-[3-fluoro-5-(trifluoromethyl)benzoyl]phenoxy}-N-(5-methyl-1H-benzimidazol-6-yl)acetamide;
- 45 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-1-(2,3-dihydro-1H-indol-1-yl)-1-ethanone

Compounds of the present invention that are advantageous are those wherein R<sup>1</sup> is C<sub>6</sub>-<sup>14</sup> aryl substituted in the meta position, particularly with halogen and wherein R<sup>3</sup> is hydrogen and R<sup>4</sup> is C<sub>6</sub>-<sub>14</sub>aryl substituted with C<sub>1</sub>-<sub>8</sub>alkyl, in particular methyl, in addition to one or more other substituents as defined above.

5

The term "alkyl", alone or in combination with any other term, refers to a straight-chain or branched-chain saturated aliphatic hydrocarbon radical containing the specified number of carbon atoms. Examples of alkyl radicals include, but are not limited to, methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, pentyl, isoamyl, 10 n-hexyl and the like.

The term "alkenyl," alone or in combination with any other term, refers to a straight-chain or branched-chain alkyl group with at least one carbon-carbon double bond. Examples of alkenyl radicals include, but are not limited to, ethenyl, propenyl, 15 isopropenyl, butenyl, isobutylenyl, pentenyl, hexenyl, hexadienyl and the like.

The term "alkynyl" refers to hydrocarbon groups of either a straight or branched configuration with one or more carbon-carbon triple bonds which may occur in any stable point along the chain, such as ethynyl, propynyl, butynyl, pentynyl, and the like.

20

The term "alkoxy" refers to an alkyl ether radical, wherein the term "alkyl" is defined above. Examples of suitable alkyl ether radicals include, but are not limited to, methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, isobutoxy, sec-butoxy, tert-butoxy and the like.

25

The term "aryl," alone or in combination with any other term, refers to a carbocyclic aromatic radical (such as phenyl or naphthyl) containing the specified number of carbon atoms, preferably from 6-14 carbon atoms, and more preferably from 6-10 carbon atoms. Examples of aryl radicals include, but are not limited to phenyl, naphthyl, indenyl, indanyl, azulenyl, fluorenyl, anthracenyl and the like.

30

The term "heterocycle" or "heterocyclic" as used herein, refers to a 3-to 7- membered monocyclic heterocyclic ring or 8-to 11- membered bicyclic heterocyclic ring which is

infection has become latent. The term "prophylactically effective amount" refers to an amount effective in preventing a virus infection, for example an HIV infection, or preventing the occurrence of symptoms of such an infection, in a patient. As used herein, the term "patient" refers to a mammal, including a human.

5

The term "pharmaceutically acceptable carrier or adjuvant" refers to a carrier or adjuvant that may be administered to a patient, together with a compound of this invention, and which does not destroy the pharmacological activity thereof and is nontoxic when administered in doses sufficient to deliver a therapeutic amount of the antiviral agent.

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As used herein, the compounds according to the invention are defined to include pharmaceutically acceptable derivatives thereof. A "pharmaceutically acceptable derivative" means any pharmaceutically acceptable salt, ester, salt of an ester, or other derivative of a compound of this invention which, upon administration to a recipient, is capable of providing (directly or indirectly) a compound of this invention or an inhibitorily active metabolite or residue thereof. Particularly favored derivatives and prodrugs are those that increase the bioavailability of the compounds of this invention when such compounds are administered to a mammal (e.g., by allowing an orally administered compound to be more readily absorbed into the blood) or which enhance delivery of the parent compound to a biological compartment (e.g., the brain or lymphatic system) relative to the parent species.

Pharmaceutically acceptable salts of the compounds according to the invention include those derived from pharmaceutically acceptable inorganic and organic acids and bases. Examples of suitable acids include hydrochloric, hydrobromic, sulfuric, nitric, perchloric, fumaric, maleic, phosphoric, glycollic, lactic, salicyclic, succinic, toluene-p-sulfonic, tartaric, acetic, citric, methanesulfonic, ethanesulfonic, formic, benzoic, malonic, naphthalene-2-sulfonic and benzenesulfonic acids. Other acids, such as oxalic, while not in themselves pharmaceutically acceptable, may be employed in the preparation of salts useful as intermediates in obtaining the compounds of the invention and their pharmaceutically acceptable acid addition salts.

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In a further aspect of the invention there are provided the compounds according to the invention for use in medical therapy particularly for the treatment or prophylaxis of viral infections such as an HIV infection. Compounds according to the invention have been shown to be active against HIV infections, although these compounds may be active 5 against HBV infections as well.

The compounds according to the invention are particularly suited to the treatment or prophylaxis of HIV infections and associated conditions. Reference herein to treatment extends to prophylaxis as well as the treatment of established infections, symptoms, and 10 associated clinical conditions such as AIDS related complex (ARC), Kaposi's sarcoma, and AIDS dementia.

According to a particular embodiment of the present invention, there is provided a method of treatment of HIV mutant viruses that exhibit NNRTI drug resistance by 15 administering a therapeutically effective amount of a compound of the present invention or a pharmaceutically acceptable derivative thereof to a mammal, in particular a human. In particular, the compounds of the present invention may be used to treat wild-type HIV-1 as well as several resistance mutations, for example, K103N, L100I, or Y181C.

According to another aspect, the present invention provides a method for the treatment 20 or prevention of the symptoms or effects of a viral infection in an infected animal, for example, a mammal including a human, which comprises treating said animal with a therapeutically effective amount of a compound according to the invention. According to a particular embodiment of this aspect of the invention, the viral infection is a retroviral 25 infection, in particular an HIV infection. A further aspect of the invention includes a method for the treatment or prevention of the symptoms or effects of an HBV infection.

The compounds according to the invention may also be used in adjuvant therapy in the treatment of HIV infections or HIV-associated symptoms or effects, for example Kaposi's 30 sarcoma.

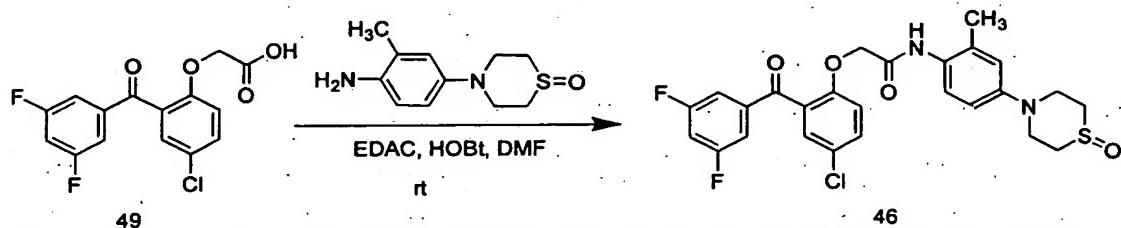
2',3'-dideoxynucleosides such as 2',3'-dideoxycytidine, 2',3'-dideoxyadenosine, 2',3'-dideoxyinosine, 2',3'-didehydrothymidine, protease inhibitors such as indinavir, ritonavir, nelfinavir, amprenavir, oxathiolane nucleoside analogues such as (-)-cis-1-(2-hydroxymethyl)-1,3-oxathiolane 5-yl)-cytosine (lamivudine) or cis-1-(2-(hydroxymethyl)-5-1,3-oxathiolan-5-yl)-5-fluorocytosine (FTC), 3'-deoxy-3'-fluorothymidine, 5-chloro-2',3'-dideoxy-3'-fluorouridine, (-)-cis-4-[2-amino-6-(cyclopropylamino)-9H-purin-9-yl]-2-cyclopentene-1-methanol (abacavir), ribavirin, 9-[4-hydroxy-2-(hydroxymethyl)but-1-yl]-guanine (H2G), tat inhibitors such as 7-chloro-5-(2-pyrryl)-3H-1,4-benzodiazepin-2-(H)one (Ro5-3335), 7-chloro-1,3-dihydro-5-(1H-pyrrol-2-yl)-3H-1,4-benzodiazepin-2-amine (Ro24-7429), interferons such as  $\alpha$ -interferon, renal excretion inhibitors such as probenecid, nucleoside transport inhibitors such as dipyridamole; pentoxifylline, N-acetylcysteine (NAC), Procysteine,  $\alpha$ -trichosanthin, phosphonoformic acid, as well as immunomodulators such as interleukin II or thymosin, granulocyte macrophage colony stimulating factors, erythropoetin, soluble CD4 and genetically engineered derivatives thereof, or other non-nucleoside reverse transcriptase inhibitors (NNRTIs) such as nevirapine (BI-RG-587), loviride ( $\alpha$ -APA) and delavuridine (BHAP), and phosphonoformic acid, and 1,4-dihydro-2H-3,1-benzoxazin-2-ones NNRTIs such as (-)-6-chloro-4-cyclopropylethynyl-4-trifluoromethyl-1,4-dihydro-2H-3,1-benzoxazin-2-one (L-743,726 or DMP-266), and quinoxaline NNRTIs such as isopropyl (2S)-7-fluoro-3,4-dihydro-2-ethyl-3-oxo-1(2H)-quinoxalinicarboxylate (HB Y1293).

The carrier(s) must be pharmaceutically acceptable in the sense of being compatible with the other ingredients of the formulation and not deleterious to the recipient thereof.

More preferably the combination therapy involves the administration of one of the above mentioned agents and a compound within one of the preferred or particularly preferred sub-groups within formulae (I) – (III) (including IA, IB, IC and ID) as described above. Most preferably the combination therapy involves the joint use of one of the above named agents together with one of the compounds of the present invention specifically named herein.

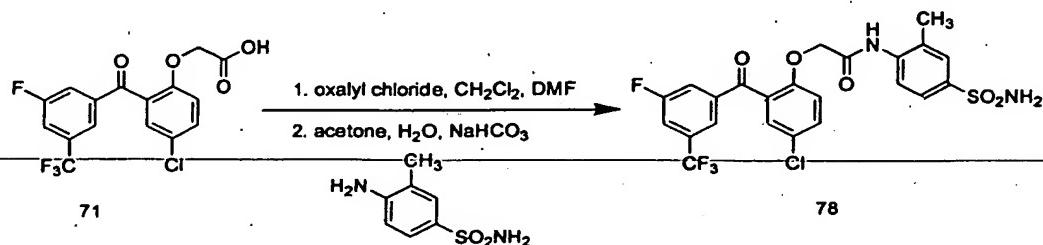
0 °C to 150 °C, most preferably at ambient temperatures. For example, carboxylic acid 49 (Scheme I) is allowed to react with amine 399 in DMF and in the presence of EDAC and HOBt at ambient temperature to provide compound 46.

**Scheme I**



5      Alternatively, compounds of formula IV, wherein R<sub>1</sub>, R<sub>2</sub>, and R<sub>5</sub> are as hereinbefore defined, can first be converted to the corresponding acid chloride which is then allowed to react with compounds of formula V, wherein R<sub>3</sub> and R<sub>4</sub> are as hereinbefore defined, to afford compounds of (I). The preparation of the desired acid chloride can be accomplished by methods well-known in the art. The carboxylic acids can be allowed to react with a suitable dehydrating agent such as thionyl chloride or more preferably oxalyl chloride. These reactions are typically performed in an aprotic solvent such as acetonitrile or pyridine or a chlorinated solvent such as chloroform or more preferably dichloromethane. The corresponding acid chlorides are not typically isolated in pure form, but instead are allowed to react directly with compounds of formula V. Most often, 10     reactions of the acid chlorides are performed in an aprotic solvent such as acetonitrile or chloroform, or more preferably in acetone. In addition, the presence of a compound capable of acting as a base such as triethylamine or pyridine, or more preferably sodium bicarbonate, is required in order to obtain sufficient yields of the coupling products. When 15     inorganic bases such as sodium bicarbonate are used, the addition of a small amount of water to the reaction mixture promotes an efficient coupling reaction. For example, 20     carboxylic acid 71 (Scheme II) is allowed to react with oxalyl chloride in dichloromethane and in the presence of a catalytic amount of DMF to afford the corresponding acid chloride. The acid chloride is then allowed to react with amine 466 in a mixture of acetone and water and in the presence of an excess of sodium bicarbonate to provide compound 78

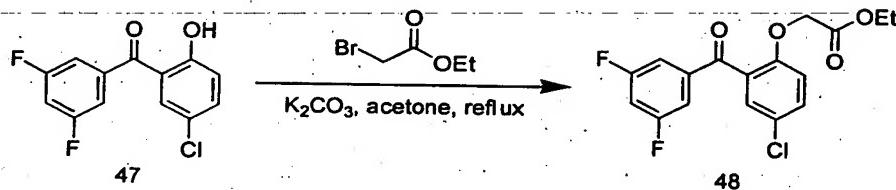
25      **Scheme II**



halogen, preferably chlorine or bromine, or a methanesulfonate or para-toluenesulfonate ester. Typically, the reactions are performed in an aprotic solvent such as acetonitrile, DMF, or more preferably acetone, and temperatures ranging from 40 °C to 100 °C. In addition, the presence of an excess of a base such as triethylamine, pyridine, or more 5 preferably potassium carbonate, is usually required for efficient reaction. For example, phenol 47 (Scheme IV) is allowed to react with ethyl bromoacetate in refluxing acetone and in the presence of potassium carbonate to afford ester 48.

Compounds of formula VII are either commercially available or can be prepared using literature methods that are known in the art.

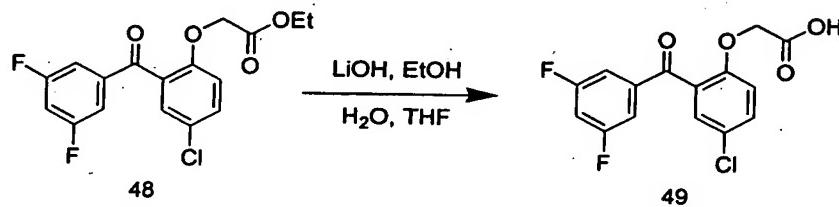
#### 10 Scheme IV



Compounds of formula IV, in which R<sub>1</sub>, R<sub>2</sub> and R<sub>5</sub> are as hereinbefore defined and R<sub>6</sub> is hydrogen can be prepared from compounds of formula IV in which R<sub>1</sub>, R<sub>2</sub> and R<sub>5</sub> are as hereinbefore defined and R<sub>6</sub> is C<sub>1</sub>-6alkyl, by reaction with aqueous base or other suitable 15 methods known in the art. A variety of inorganic bases can be used to affect the saponification of the esters of formula IV, such as sodium carbonate, sodium hydroxide or more preferably lithium hydroxide. Typically, these reactions are performed in water in addition to a solvent that is miscible with water and is capable of dissolving the compounds of formula IV such as tetrahydrofuran, methyl alcohol or ethyl alcohol.

For example, ester 48 (Scheme V) is allowed to react with lithium hydroxide in a mixture of THF, water, and ethanol to afford carboxylic acid 49.

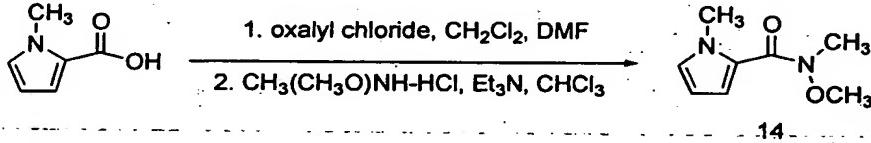
#### Scheme V



Compounds of formula IX, in which R<sub>5</sub> is as hereinbefore defined, R<sub>7</sub> is methyl and R<sub>9</sub> is either bromine or iodine are either commercially available or can be prepared using literature methods known in the art.

- Compounds of formula X, in which R<sub>1</sub> is as hereinbefore defined and R<sub>10</sub> is N,O-dimethylhydroxylamino, can be prepared from compounds of formula X in which R<sub>10</sub> is a suitable leaving group, preferably chlorine, by reaction with N,O-dimethylhydroxylamine in an aprotic solvent, preferably acetonitrile, chloroform or dichloromethane, and in the presence of a base, preferably triethylamine. Compounds of formula X in which R<sub>10</sub> is chlorine can be prepared from compounds of formula X, in which R<sub>10</sub> is hydroxy, using literature methods known in the art, such as reaction with oxalyl chloride in an aprotic solvent, preferably dichloromethane or chloroform and in the presence of a catalytic amount of DMF. For example, 1-methyl-2-pyrrolecarboxylic acid (Scheme VII) in dichloromethane is allowed to react with excess oxalyl chloride in the presence of a catalytic amount of DMF. The resulting acid chloride is not isolated in pure form, but instead is allowed to react with N,O-dimethylhydroxylamine in chloroform and in the presence of triethylamine, to afford amide 14.

### Scheme VII



- Alternatively, compounds of formula VI, in which R<sub>1</sub> and R<sub>5</sub> are as hereinbefore defined and R<sub>7</sub> is methyl can be prepared by reaction of compounds of formula IX with those of formula X, wherein R<sub>1</sub> and R<sub>5</sub> are as hereinbefore defined with the further stipulation that these groups are chemically compatible with the reaction conditions, R<sub>7</sub> is methyl, R<sub>9</sub> is a halogen, preferably bromine or iodine, and R<sub>10</sub> is N,O-dimethylhydroxylamino. Compounds of formula IX can be converted to a species in which R<sub>9</sub> is a magnesium halide, such as magnesium bromide or magnesium iodide, so-called Grignard reagents. The species containing the magnesium halide is then allowed to react with compounds of formula X, in which R<sub>10</sub> is N,O-dimethylhydroxylamino. These reactions are typically performed in ethereal solvents such as THF, dioxane or diethyl

Alternatively, compounds of formula VI, in which R<sub>1</sub> and R<sub>5</sub> are as hereinbefore

defined and R<sub>7</sub> is methyl, can be prepared by reaction of compounds of formula IX with those of formula X, wherein R<sub>1</sub> and R<sub>5</sub> are as hereinbefore defined, with the further

stipulation that these groups are chemically compatible with the reaction conditions, R<sub>7</sub> is methyl, R<sub>9</sub> is a halogen, preferably bromine or iodine, and R<sub>10</sub> is hydrogen. Compounds of

5     methyl, R<sub>9</sub> is a halogen, preferably bromine or iodine, and R<sub>10</sub> is hydrogen. Compounds of formula IX can be converted to a species in which R<sub>9</sub> is a magnesium halide, such as

magnesium bromide or magnesium iodide, so-called Grignard reagents. The species

containing the magnesium halide is then allowed to react with compounds of formula X, in which R<sub>10</sub> is hydrogen, to afford an intermediate alcohol. These reactions are typically

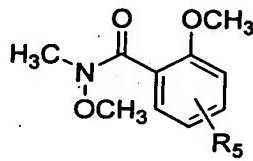
performed in ethereal solvents such as THF, dioxane or diethyl ether and at temperatures from 0 °C to 100 °C, preferably ambient temperature. The preparation of compounds of

formula IX, in which R<sub>9</sub> is a magnesium halide, can be accomplished by literature methods known in the art. Typically, a compound of formula IX, in which R<sub>9</sub> is either

bromine or iodine, is allowed to react with elemental magnesium, in an aprotic, ethereal solvent. The reaction is described in the following section.

solvent. The intermediate alcohol is then allowed to react with an agent capable of oxidizing it to the desired ketone, preferably manganese (IV) oxide, in an aprotic solvent, preferably dichloromethane or chloroform, and at ambient temperature.

Lastly, compounds of formula VI, in which  $R_1$  and  $R_5$  are as hereinbefore defined and  $R_7$  is methyl, can be prepared by reaction of compounds of formula XII, in which  $R_5$  is as hereinbefore defined, with compounds of formula XIII, in which  $R_1$  is as hereinbefore defined, and  $R_{11}$  is a halogen, preferably bromine or iodine, with the further stipulation that  $R_1$  and  $R_5$  are chemically compatible with subsequent chemical steps.



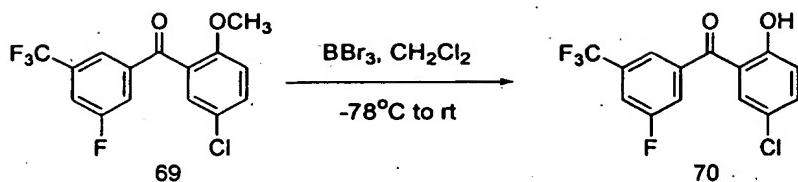
XII

R<sub>1</sub>-R<sub>11</sub>

XIII

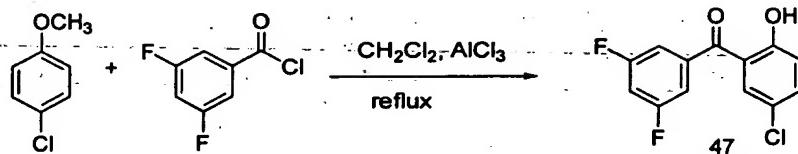
Typically, compounds of formula XIII, in which R<sub>11</sub> is a halogen, preferably iodine or

25 bromine, are treated with an agent capable of effecting a halogen-metal exchange reaction, preferably n-butyl lithium, in an ethereal solvent, preferably diethyl ether and at low temperature, preferably -78 °C.



Alternatively, compounds of formula VI, in which R<sub>1</sub> and R<sub>5</sub> are as hereinbefore defined, and R<sub>7</sub> is hydrogen, can be prepared by reaction of compounds of formula IX, in which R<sub>5</sub> is as hereinbefore defined, R<sub>9</sub> is hydrogen and R<sub>7</sub> is methyl, with compounds of formula X, in which R<sub>1</sub> is as hereinbefore defined, and R<sub>10</sub> is a halogen, preferably chlorine, with the further stipulation that R<sub>1</sub> and R<sub>5</sub> are chemically compatible with the reaction conditions. These reactions, typically called Friedel-Craft acylations, are performed in an aprotic solvent such as nitrobenzene, 1,2-dichloroethane, sulfolane, or more preferably dichloromethane, at temperatures ranging from 0 °C to 150 °C, preferably 5-10 °C. In addition, the use of a compound which is capable of acting as a Lewis acid, such as titanium (IV) chloride, tin (IV) chloride, or more preferably aluminum chloride is required. For example, 4-chloroanisole (Scheme X) is allowed to react with 3,5-difluorobenzoyl chloride in refluxing dichloromethane in the presence of aluminum chloride to afford ketone 47.

### 15 Scheme X

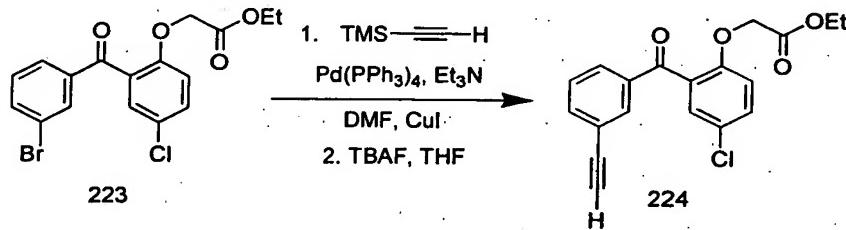


Compounds of formula X, in which R<sub>1</sub> is as hereinbefore defined, and R<sub>10</sub> is a halogen, are either commercially available or can be prepared by literature methods. Alternatively, 20 compounds of formula VI, in which R<sub>1</sub> and R<sub>5</sub> are as hereinbefore described and R<sub>7</sub> is hydrogen, can be prepared from the reaction of compounds of formula IX, in which R<sub>5</sub> is as hereinbefore defined, and R<sub>7</sub> and R<sub>9</sub> are hydrogen, with compounds of formula X, in which R<sub>1</sub> is as hereinbefore defined and R<sub>10</sub> is a halogen, preferably chlorine. These reactions, typically called Fries rearrangements, are performed in an aprotic solvent, such as nitrobenzene, sulfolane or chloroform and at temperatures ranging from 0 °C to 150 °C. 25 In addition, the reaction typically requires the presence of a compound capable of acting as

palladium on carbon and Raney nickel. In addition, the presence of a reducing agent such as ammonium formate or pressurized hydrogen gas is required. These reactions are typically performed in a solvent capable of dissolving the olefinic substrate such as ethyl acetate, acetone, methyl alcohol or ethyl alcohol.

Compounds of formula VI in which R<sub>1</sub> is C<sub>6-14</sub> aryl or C<sub>6-14</sub> heterocycle, substituted with C<sub>2-8</sub> alkynyl groups, can be prepared from compounds of formula XIV, in which R<sub>5</sub> is as hereinbefore described, R<sub>7</sub> is hydrogen, methyl or methylene carboxyl ester and R<sub>12</sub> is a group capable of undergoing a palladium-catalyzed reaction, preferably iodine or bromine, by reaction with C<sub>2-8</sub> alkynes. These reactions are typically performed in the presence of a palladium catalyst such as tetrakis(triphenylphosphine)palladium, palladium dichloride bis(acetonitrile), or palladium acetate. The solvents for these reactions are typically aprotic solvents such as acetonitrile, or more preferably DMF. The reactions are usually performed at temperatures ranging from ambient temperature to 130 °C, preferably 50-90 °C. In addition, the presence of a base such as potassium or sodium carbonate, or triethylamine, is usually required. Furthermore, reactions of some substrates may require the addition of a compound which is capable of stabilizing any intermediate palladium species. These compounds are most often triaryl arsine or phosphine derivatives, such as triphenylphosphine, or tri-ortho-tolylphosphine. Lastly, these reactions require the presence of a catalytic amount of copper (I) iodide. For example, ester 223 (Scheme XI) is allowed to react with trimethylsilylacetylene, in the presence of tetrakis(triphenylphosphine)palladium, triethylamine and copper (I) iodide, to afford the intermediate trimethylsilyl-protected product. Treatment of the intermediate with tetrabutylammonium fluoride in THF provides compound 224

### Scheme IX



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The C<sub>2-8</sub> alkenes used in these reactions are either commercially available or can be prepared by literature methods familiar to those skilled in the art.

functional group. Among these agents are copper (I) cyanide or a palladium catalyst in combination with an appropriate cyanide source such as potassium cyanide, sodium cyanide, or zinc cyanide. Among the palladium agents that can be employed for this transformation are tertrakis(triphenylphosphine)palladium, palladium acetate, or palladium dichloride bis(acetonitrile). These reactions are typically conducted in aprotic solvents such as acetonitrile, or more preferably DMF, and in the presence of phosphine ligand, such as triphenylphosphine, and at temperatures from 20 °C to 150 °C, preferably 80-85 °C.

Compounds of formula VI, in which R<sub>1</sub> is as hereinbefore described, R<sub>7</sub> is hydrogen, methyl or methylene carboxy ester and R<sub>5</sub> is hydrogen, halogen, nitro, trifluoromethyl, C<sub>1</sub>-<sub>8</sub> alkyl or alkoxy can be prepared from commercially available material using processes described herein or by literature methods familiar to those skilled in the art.

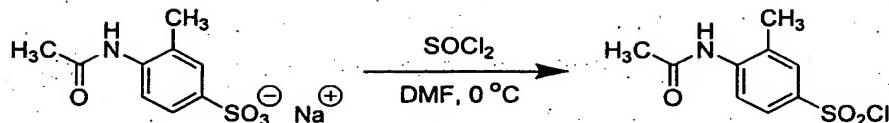
Compounds of formula VI, in which R<sub>1</sub> is as previously described, R<sub>7</sub> is hydrogen, methyl or methylene carboxy ester, and R<sub>5</sub> is amino, can be prepared from compounds of formula VI in which R<sub>5</sub> is nitro by reaction with agents or a combination of agents capable of reducing a nitro group to an amino functionality. Among these combination of agents are a metal containing compound, such as elemental iron, palladium or Raney nickel and a reducing agent, such as ammonium formate, formic acid, hydrochloric acid or pressurized hydrogen gas. These reactions are typically performed in a solvent such as ethyl acetate, acetone, methyl alcohol or ethyl alcohol and at temperatures ranging from 20 °C to 100 °C, preferably ambient temperature.

Compounds of formula VI in which R<sub>1</sub> is as hereinbefore defined, R<sub>7</sub> is hydrogen, methyl or methylene carboxy ester, and R<sub>5</sub> is C<sub>1</sub>-<sub>8</sub> alkylamino can be prepared from compounds of formula VI in which R<sub>5</sub> is amino, by reaction with agents capable of selectively alkylating the amino group. Among these agents are alkyl halides, such as methyl iodide, alkylsulfonate esters or alkylaryl sulfonate esters. These reactions are typically performed in polar, aprotic solvents such as N-methylpyrrolidine or DMF and at temperatures ranging from ambient to 150 °C.

Compounds of formula V, in which R<sub>3</sub> and R<sub>4</sub>, which may be the same or different, are hydrogen, hydroxy, C<sub>1</sub>-<sub>8</sub>alkyl, heterocycle, C<sub>6</sub>-<sub>14</sub>arylheterocycle or C<sub>6</sub>-<sub>14</sub>aryl are commercially available or can be prepared by literature methods familiar to those skilled in the art.

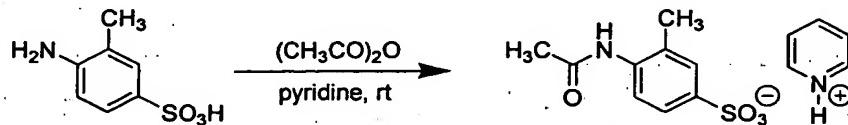
Compounds of formula XV, in which R<sub>14</sub> is a nitrogen protecting group, such as trifluoromethyl acetyl, or more preferably acetyl, R<sub>15</sub> is hydrogen, halogen, C<sub>1</sub>-alkyl, C<sub>1</sub>-alkoxy, nitro, nitrile, trifluoromethyl, and R<sub>16</sub> is -SO<sub>2</sub>Cl, can be prepared from compounds of formula XV, in which R<sub>16</sub> is -SO<sub>3</sub>H or a salt thereof, by reaction with an agent capable of converting a sulfonic acid or a salt thereof to a sulfonyl chloride. Among the agents that are capable of affecting this transformation are phosphorous oxychloride (POCl<sub>3</sub>), or thionyl chloride. These reactions are conducted in an aprotic solvent such as DMF, and at temperatures from -10 °C to 100 °C, preferably 0 °C. For example, compound X (Scheme XIV) is allowed to react with thionyl chloride in DMF at 0 °C to provide sulfonyl chloride X.

#### Scheme XIV

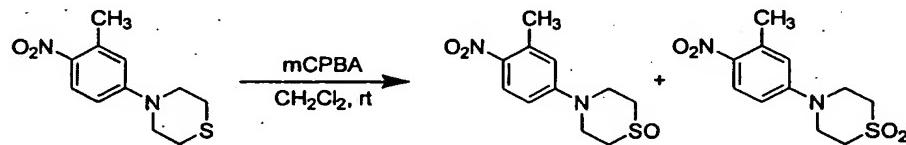


Compounds of formula XV, in which R<sub>14</sub> is a nitrogen protecting group, such as trifluoromethyl acetyl, or more preferably acetyl, R<sub>15</sub> is hydrogen, halogen, C<sub>1</sub>-alkyl, C<sub>1</sub>-alkoxy, nitro, nitrile, trifluoromethyl, and R<sub>16</sub> is -SO<sub>3</sub>H or a salt thereof, can be prepared from compounds of formula XV, in which R<sub>14</sub> is hydrogen, by reaction with an agent capable of selectively protecting the amino group. Among the reagents that are capable of affecting this transformation are trifluoroacetic anhydride, acetyl chloride, or more preferably acetic anhydride. These reactions are conducted in an aprotic solvent, such as acetonitrile, dichloromethane, chloroform, or more preferably pyridine, and at temperatures from 0 °C to 100 °C, preferably ambient temperatures. For example, compound X (Scheme XV) is allowed to react with acetic anhydride in pyridine at ambient temperature to provide compound X.

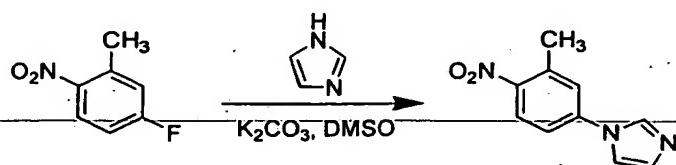
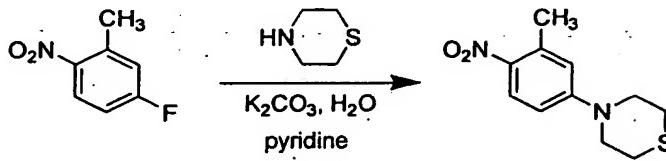
#### Scheme XV



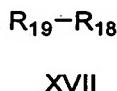
chloroperbenzoic acid (mCPBA), hydrogen peroxide, or oxone. These reactions are typically performed in solvents such as water, THF, acetonitrile, dichloromethane, methyl alcohol, ethyl alcohol, or a mixture thereof and at temperatures from 0 °C to 100 °C. For example, compound X (Scheme XVII) is allowed to react with MCPBA in chloroform at room temperature to provide both the sulfoxide X and the sulfone X.

**Scheme XVII**

Compounds of formula XVI, in which R<sub>15</sub> is hydrogen, halogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkoxy, nitro, nitrile, trifluoromethyl, and R<sub>17</sub> is a heterocycle substituted with -S, or -O can be prepared from compounds of formula XVI, in which R<sub>17</sub> is or contains a suitable leaving group, such as a halide, preferably fluorine, chlorine, or bromine, by reaction with heterocyclic compounds capable of displacing the leaving group. Among the heterocycles that can affect this transformation are imidazole, 1,2,3-triazole, 1,2,4-triazole, morpholine, thiomorpholine, N-methylpiperazine, piperazine, and piperidine. These reactions are typically performed in an aprotic solvent such as dioxane, THF, dimethylsulfoxide or pyridine, and in the presence of a base such as triethylamine, or more preferably sodium or potassium carbonate, and at temperatures from 0 °C to 150 °C, preferably 50-100 °C. Two such examples are shown below in Scheme XIX. In the first example, 5-fluoro-2-nitrotoluene is allowed to react with thiomorpholine in pyridine and water and in the presence of potassium carbonate to afford compound X. In the second example, 5-fluoro-2-nitrotoluene is allowed to react with imidazole in dimethylsulfoxide, in the presence of potassium carbonate, at 70 °C to provide compound X.

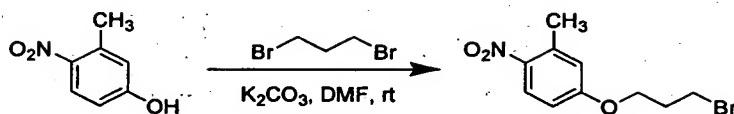
**Scheme XIX**

hereinbefore defined, or heterocycle, and R<sub>19</sub> is a leaving group, preferably bromine or chlorine. These reactions are usually conducted in an aprotic solvent such as DMF, N-methylpyrrolidine, acetonitrile, or pyridine. In addition, the presence of a base such as triethylamine, or more preferably sodium or potassium carbonate is usually required. For example, 4-nitro-3-methylphenol (Scheme XXI) is allowed to react with 1,3-dibromopropane in DMF and in the presence of potassium carbonate to afford compound X.



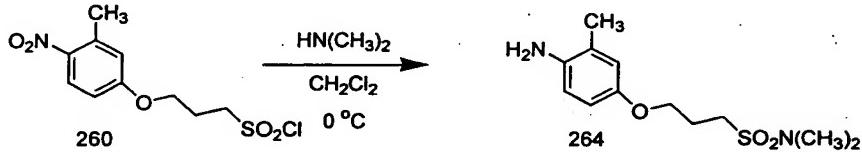
Scheme XXI

10



Compounds of formula XVI, in which R<sub>15</sub> is hydrogen, halogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkoxy, nitro, nitrile, or trifluoromethyl, and R<sub>17</sub> is -OR<sub>8</sub>, wherein R<sub>8</sub> is C<sub>1-8</sub>alkyl substituted with -SO<sub>2</sub>NR<sub>6</sub>R<sub>7</sub>, can be prepared from compounds of formula XVI, in which R<sub>8</sub> is C<sub>1-8</sub>alkyl substituted with -SO<sub>2</sub>Cl, by reaction with ammonia or an appropriate amine. These reactions are typically performed in aprotic solvents such as acetonitrile, or more preferably dichloromethane or chloroform. For example, sulfonyl chloride 260 (Scheme XXII) is allowed to react with dimethylamine in dichloromethane at 0 °C to provide sulfonamide 264.

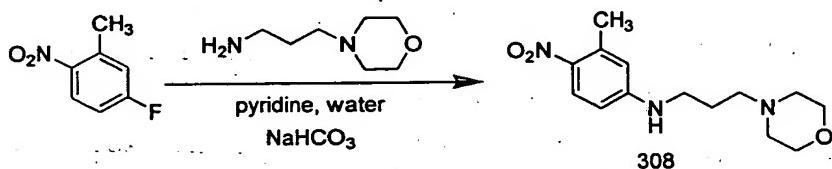
20 Scheme XXII



Compounds of formula XVI in which R<sub>15</sub> is hydrogen, halogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkoxy, nitro, nitrile, or trifluoromethyl, and R<sub>17</sub> is -OR<sub>8</sub>, wherein R<sub>8</sub> is C<sub>1-8</sub>alkyl substituted with -SO<sub>2</sub>Cl, can be prepared from compounds of formula XVI in which R<sub>17</sub> is -OR<sub>8</sub> and R<sub>8</sub> is

solvents such as DMF, acetonitrile, dioxane, water, pyridine, or a mixture thereof, and in the presence of a base such as sodium or potassium carbonate, or more preferably sodium bicarbonate. For example, 5-fluoro-2-nitrotoluene (Scheme XXV) is allowed to react with 4-(3-aminopropyl)morpholine in pyridine and water and in the presence of sodium bicarbonate to provide compound 308.

**Scheme XXV**



The desired amines of formula  $\text{HNR}_6\text{R}_7$  are either commercially available or can be prepared using literature methods known in the art.

Compounds of formula V, in which  $\text{R}_3$  is hydrogen and  $\text{R}_4$  is an aromatic heterocycle, are either commercially available or can be prepared using literature methods familiar to those skilled in the art.

A further object of the present invention features intermediates 7, 32, 33, 36, 38, 44, 45, 49, 51, 52, 61, 65, 66, 71, 75, 76, 111, 112, 115, 118, 119, 128, 129, 171, 172, 191, 192, 199, 200, 206, 207, 224, 225, 232, 233, 235, 236, 246, 247, 253, 254, 255, 256, 259, 260, 261, 262, 264, 265, 267, 268, 288, 289, 290, 409, 412, 428, 430, 431, 433, useful in the manufacture of the compounds of the present invention.

The compounds according to the invention, also referred to herein as the active ingredient, may be administered for therapy by any suitable route including oral, rectal, nasal, topical (including transdermal, buccal and sublingual), vaginal and parenteral (including subcutaneous, intramuscular, intravenous, intradermal, and intravitreal). It will be appreciated that the preferred route will vary with the condition and age of the recipient, the nature of the infection and the chosen active ingredient.

In general a suitable dose for each of the above-mentioned conditions will be in the range of 0.01 to 250 mg per kilogram body weight of the recipient (e.g. a human) per day,

thereof and at least one further therapeutic agent are presented separately from one another as a kit of parts.

Compositions suitable for transdermal administration may be presented as discrete patches adapted to remain in intimate contact with the epidermis of the recipient for a prolonged period of time. Such patches suitably contain the active compound 1) in an optionally buffered, aqueous solution or 2) dissolved and/or dispersed in an adhesive or 3) dispersed in a polymer. A suitable concentration of the active compound is about 1% to 5 25%, preferably about 3% to 15%. As one particular possibility, the active compound 10 may be delivered from the patch by electrotransport or iontophoresis as generally described in *Pharmaceutical Research* 3 (6), 318 (1986).

Formulations of the present invention suitable for oral administration may be presented as discrete units such as capsules, caplets, cachets or tablets each containing a 15 predetermined amount of the active ingredients; as a powder or granules; as a solution or a suspension in an aqueous or non-aqueous liquid; or as an oil-in-water liquid emulsion or a water-in-oil liquid emulsion. The active ingredient may also be presented as a bolus, electuary or paste.

20 A tablet may be made by compression or molding, optionally with one or more accessory ingredients. Compressed tablets may be prepared by compressing in a suitable machine the active ingredients in a free-flowing form such as a powder or granules, optionally mixed with a binder (e.g. povidone, gelatin, hydroxypropylmethyl cellulose), lubricant, inert diluent, preservative, disintegrant (e.g. sodium starch glycollate, cross-linked povidone, cross-linked sodium carboxymethyl cellulose) surface-active or dispersing agent. Molded tablets may be made by molding a mixture of the powdered compound moistened with an inert liquid diluent in a suitable machine. The tablets may 25 optionally be coated or scored and may be formulated so as to provide slow or controlled release of the active ingredients therein using, for example, hydroxypropylmethyl cellulose in varying proportions to provide the desired release profile. Tablets may 30 optionally be provided with an enteric coating, to provide release in parts of the gut other than the stomach.

Preferred unit dosage formulations are those containing a daily dose or daily subdose of the active ingredients, as hereinbefore recited, or an appropriate fraction thereof.

It should be understood that in addition to the ingredients particularly mentioned above  
5 the formulations of this invention may include other agents conventional in the art having regard to the type of formulation in question, for example, those suitable for oral administration may include such further agents as sweeteners, thickeners and flavoring agents.

10 The following examples are intended for illustration only and are not intended to limit the scope of the invention in any way. "Active ingredient" denotes a compound according to the invention or multiples thereof or a physiologically functional derivative of any of the aforementioned compounds.

15 **General Procedures:**

**General procedure I: Friedel-Crafts reaction of acid chlorides with 4-chloroanisole**

Into a round-bottom flask equipped with a stir bar, a reflux condenser, and nitrogen on demand, were placed 4-chloroanisole (1-1.25 mmol/mmol of acid chloride), aluminum chloride ( $\text{AlCl}_3$ , 1-1.75 mmol/mmol of acid chloride) and  $\text{CH}_2\text{Cl}_2$ . To the resulting mixture was added the appropriate acid chloride at rt. When the addition was complete, the orange mixture was heated to reflux and was allowed to stir for 2-24 h. The mixture was allowed to cool to rt and was carefully poured onto ice water, giving a two-phase mixture which was stirred at rt for 30 min to 2 h. It was then poured into a separatory funnel containing water. The organic layer was collected, washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure. See specific examples for details regarding additional purification.

30 **General procedure II: Alkylation of phenols with ethyl bromoacetate**

Into a round-bottom flask equipped with a stir bar, reflux condenser, and nitrogen on demand were placed the appropriate phenol, potassium carbonate (2-10 mmol/mmol of phenol), ethyl bromoacetate (1-1.5 mmol/mmol of phenol) and acetone (1-10 mL/mmol of

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**General Procedure V: Synthesis of acid chlorides from carboxylic acids using oxalyl chloride**

- 5 Into a round-bottom flask were placed the appropriate carboxylic acid, methylene chloride ( $\text{CH}_2\text{Cl}_2$ , 1-10 mL/mmol acid), and N,N-dimethylformamide (1-10 drops). The mixture was cooled to 0 °C and oxalyl chloride (1-2 mmol/mmol acid) was added dropwise, after which time the mixture was allowed to warm to rt and stir for 1-24 h. The solvents were then removed under reduced pressure and the remaining residue was dried in vacuo. In  
10 most cases, the acid chlorides were used immediately used in subsequent reactions with no further purification.

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**General procedure VI: Coupling of acid chlorides to aromatic amines using sodium bicarbonate**

- 15 Into a round-bottom flask were placed the appropriate aromatic amine, acetone (1-10 mL/mmol amine), sodium bicarbonate (2-10 mmol/mmol amine), and water (0.25-10 mL). The acid chloride was added as a solution in acetone (1-10 mL/mmol of acid chloride) in a  
20 dropwise manner and the reaction mixture was allowed to stir at rt for 1-24 h. When judged to be complete, the mixture was poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure. See specific examples for details regarding further purification of the products.

25

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**General procedure VII: Synthesis of Weinreb amides from acid chlorides using N,O-dimethylhydroxylamine hydrochloride**

- 30 Into a round bottom flask equipped with a stir bar and nitrogen on demand were placed the N,O-dimethylhydroxylamine (1-2 mmol/mmol acid chloride) and chloroform ( $\text{CHCl}_3$ , 1-10 mL/mmol acid chloride). The mixture was cooled to 0 °C and triethylamine ( $\text{Et}_3\text{N}$ , 1-5 mmol/mmol acid chloride) was added in one portion. The acid chloride was added and the reaction mixture was allowed to stir at 0 °C for 0.5-5 h, after which time was poured into a  
35 separatory funnel containing chloroform and water. The organics were collected, washed with water and brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under

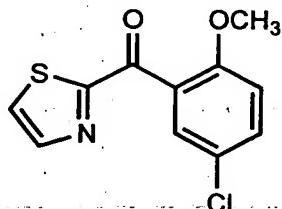
dissolved, and washed with water. The resulting organics were dried over MgSO<sub>4</sub> and concentrated in vacuo and purified as described in the individual cases.

**General Procedure XI.** An amine (1-2.5 mmol/mmol benzene) was added dropwise via  
5 an addition funnel to a stirred suspension of a para-nitro halogenated benzene or toluene in pyridine (20-40 mmol/mmol benzene), sodium bicarbonate (1.5-4 mmol/mmol benzene), and water (0.2-5 mL/mmol benzene). The resulting suspension was refluxed (150 °C) for  
10 1-7 days. The mixture was filtered and acetone (10-200 mL/mmol benzene) was added to the filtrate and brought to reflux. Water was added to the cloud point and the solution was cooled to rt. The precipitate was filtered and the resulting solid was washed with water and ether to afford the substituted product.

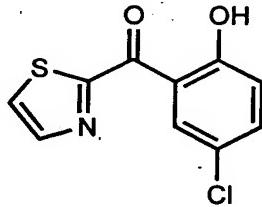
**General Procedure XII.** The appropriate nitro-benzene was added to a suspension of palladium on carbon (0.1-0.8 mmol /mmol benzene, 10% w/w), ethanol, THF, and  
15 methanol and the reaction vessel was evacuated and charged with nitrogen several times. After evacuating the reaction vessel under reduced pressure, it was charged with hydrogen (14-100 psi). The resulting suspension was stirred at rt for 0-72 h, filtered through a celite pad, and concentrated in vacuo to afford the appropriate aniline.

20 **General procedure XIII.** Into a round-bottom flask equipped with a stir bar, cooling bath, and nitrogen on demand were placed the appropriate carboxylic acid, hexachloroacetone (HCA, 0.5 mmol/mmol acid), and THF (1-10 mL/mmol acid) and the mixture was cooled -78 °C. Triphenylphosphine (PPh<sub>3</sub>, 1 mmol/mmol acid) in THF (1-10 mL/mmol acid) was added to the mixture and stirred for 5-120 min. The appropriate aniline (1 mmol/mmol acid) in THF (1-10 mL/mmol acid) and pyridine (5-20 mmol/mmol acid) were added dropwise and the mixture was stirred -78 °C for 5-60 min. The cooling bath was removed and the mixture was stirred at rt for 1h to 14 d. The reaction mixture was concentrated in vacuo and purified as described in the individual cases.

30 **General procedure XIV.** Thionyl chloride (1-100 mmol/mmol acid) was added to a solution of the appropriate carboxylic acid in methylene chloride (1-100 ml/mmol acid) and the resulting solution was refluxed for 1-12 h under nitrogen. The mixture was concentrated in vacuo and placed under nitrogen to afford the appropriate acid chloride.

**Step B:****3**

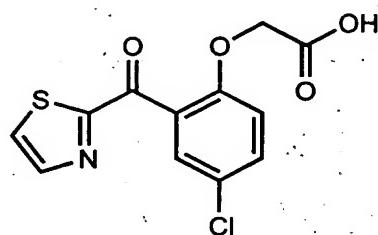
- 5   **2** (5.21 g, 20.6 mmol), manganese dioxide (17.66 g, 203.1 mmol) and methylene chloride ( $\text{CH}_2\text{Cl}_2$ , 75 mL) were combined under nitrogen and were allowed to stir at RT for 2.5 h. The mixture was filtered through a pad of celite, which was washed with several portions of  $\text{CH}_2\text{Cl}_2$ , and the solvent was removed under reduced pressure to provide a tan solid (4.96 g, 95%) which was used in subsequent reactions without any further purification.  $^1\text{H}$
- 10   **NMR** ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  8.06 (d,  $J= 3$  Hz, 1H), 7.76 (d,  $J= 3$  Hz, 1H), 7.63 (d,  $J= 3$  Hz, 1H), 7.49 (dd,  $J= 9, 3$  Hz, 1H), 7.00 (d,  $J= 9$  Hz, 1H), 3.82 (s, 3H).

**Step C:****4**

- 15   **3** (4.96 g, 19.6 mmol), in  $\text{CH}_2\text{Cl}_2$  (60 mL) was cooled to  $-78^\circ\text{C}$  and boron tribromide (100 mL of a 1.0 M solution in  $\text{CH}_2\text{Cl}_2$ , 100 mmol) was added via syringe over 30 min. The resulting purple solution was allowed to stir at  $-78^\circ\text{C}$  for 15 min, after which time it was allowed to slowly warm to RT. After 30 min at RT, the mixture was slowly poured over ice water and the resulting two-phase mixture was allowed to stir for 30 min. The mixture
- 20   was then poured into a separatory funnel containing water and  $\text{CH}_2\text{Cl}_2$ . The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , and the solvents were removed under reduced pressure. The product was isolated by flash chromatography using 7:3 hexane/  $\text{CH}_2\text{Cl}_2$  to provide a yellow solid (3.59 g, 76%).  $^1\text{H NMR}$  ( $\text{CDCl}_3$ , 300 MHz)

Phenol **4** (2.31 g, 9.64 mmol), K<sub>2</sub>CO<sub>3</sub> (6.95 g, 50.3 mmol), ethyl bromoacetate (1.1 mL, 1.7 g, 9.9 mmol) and acetone (150 mL) were used according to general procedure II. The product was used in the next reaction without any further purification. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 8.05 (d, J= 3 Hz, 1H), 7.76 (d, J= 3 Hz, 1H), 7.66 (d, J= 3 Hz, 1H), 7.48 (dd, J= 9, 3 Hz, 1H), 6.93 (d, J= 9 Hz, 1H), 4.61 (s, 2H), 4.21 (q, J= 6 Hz, 2H), 1.26 (t, J= 6 Hz, 3H).

**Step B:**



Ester **6** (3.1 g, 9.6 mmol), THF (30 mL), water (10 mL), EtOH (10 mL) and LiOH (1.0 g, 23.8 mmol) were used according to general procedure III. The product was used in the next reaction without any further purification. <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 8.30 (d, J = 3Hz, 1H), 8.15 (d, J= 3 Hz, 1H), 7.63 (d, J = 3 Hz, 1H), 7.57 (dd, J= 9, 3 Hz, 1H), 7.05 (d, J= 9 Hz, 1H), 4.45 (s, 2H).

**Step C:**

Carboxylic acid **7** (0.1 g, 0.33 mmol), HOBt (0.05 g, 0.4 mmol), EDAC (0.09 g, 0.46 mmol), Et<sub>3</sub>N (0.1 mL, 0.07 g, 0.72 mmol), DMF (6 mL) and 5-aminoindazole (0.05 g, 0.35 mmol) were used according to general procedure IV. The product was purified by flash chromatography using 95:5 CH<sub>2</sub>Cl<sub>2</sub>: CH<sub>3</sub>OH as eluant to provide **5** as a tan solid (0.03 g, 25%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 400 MHz) δ 9.55 (s, 1H), 8.46 (s, 1H), 8.21 (s, 1H), 8.05 (m, 2H), 7.77 (m, 3H), 7.54 (m, 1H), 6.99 (d, J= 8 Hz, 2H), 4.74 (s, 2H).

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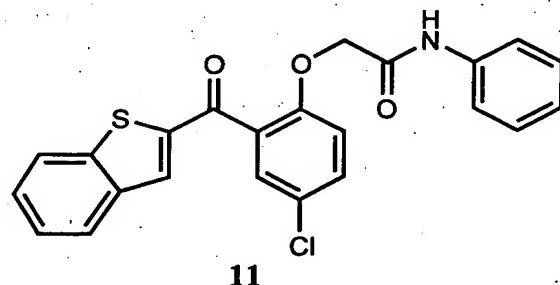
**Example 3:**

2-Benzofurancarboxylic acid (2.51 g, 15.48 mmol),  $\text{CH}_2\text{Cl}_2$  (50 mL), DMF (4 drops), and oxalyl chloride (1.5 mL, 2.18 g, 17.19 mmol) were used to prepare the corresponding acid chloride according to general procedure V. The acid chloride was used immediately in combination with 4-chloroanisole (2.16 g, 15.15 mmol),  $\text{AlCl}_3$  (3.01 g, 22.57 mmol) and  $\text{CH}_2\text{Cl}_2$  (50 mL) according to general procedure I. Compound **10** was purified by flash chromatography using 7:3 hexane/ $\text{CH}_2\text{Cl}_2$  as eluant to provide **10** as a yellow solid (2.39 g, 57%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  12.05 (s, 1H), 8.48 (d,  $J = 3\text{Hz}$ , 1H), 7.82 (d,  $J = 9\text{ Hz}$ , 1H), 7.79 (s, 1H), 7.73 (d,  $J = 9\text{ Hz}$ , 1H), 7.56 (m, 2H), 7.42 (t,  $J = 7.5\text{ Hz}$ , 1H), 7.09 (d,  $J = 9\text{ Hz}$ , 1H).

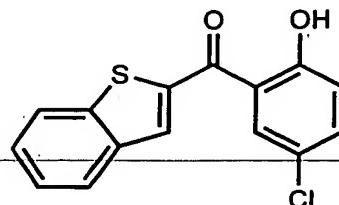
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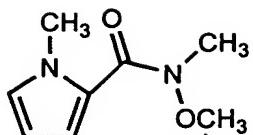
**Step B:**

Into a round-bottom flask equipped with a stir bar, a reflux condenser and nitrogen on demand were placed phenol **10** (0.14 g, 0.51 mmol), 2-chloroacetanilide (0.10 g, 0.59 mmol),  $\text{K}_2\text{CO}_3$  (0.50 g, 3.62 mmol) and acetone (10 mL). The mixture was heated to reflux for 16 h, after which time it was allowed to cool to rt and was poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure to leave orange oil. The product was purified by flash chromatography using 4:1 hexane/ethyl acetate as eluant to provide **9** as a white solid (0.12 g, 58%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  9.33 (s, 1H), 7.75 (m, 5H), 7.61 (m, 3H), 7.39 (m, 3H), 7.15 (m, 2H), 4.77 (s, 2H).

**Example 5**

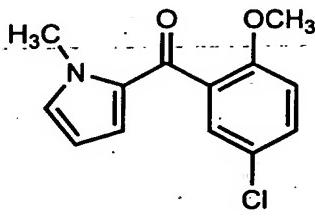
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**Step A:**

**Step A:****14**

1-Methyl-2-pyrrolecarboxylic acid (4.75 g, 37.96 mmol), CH<sub>2</sub>Cl<sub>2</sub> (100 mL), DMF (0.5 mL) and oxalyl chloride (3.6 mL, 5.24 g, 41.27 mmol) were used according to general procedure V. Into a separate flask were placed N,O-dimethylhydroxylamine hydrochloride (4.45 g, 45.62 mmol), Et<sub>3</sub>N (26 mL, 19 g, 187 mmol) and chloroform (100 mL). The resulting solution was cooled to 0 °C and the acid chloride (in 20 mL of chloroform) was added dropwise. The resulting mixture was allowed to stir at 0 °C for an additional 1 h, after which time it was allowed to warm to RT. The mixture was then poured into a separatory funnel containing chloroform and water. The organic layer was collected and was washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to afford a brown oil which was used in subsequent reactions with no further purification. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 6.95 (m, 1H), 6.78 (m, 1H), 6.15 (m, 1H), 3.94 (s, 3H), 3.73 (s, 3H), 3.36 (s, 3H).

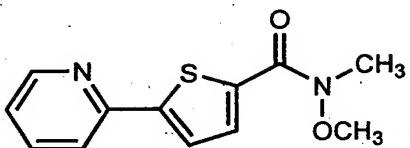
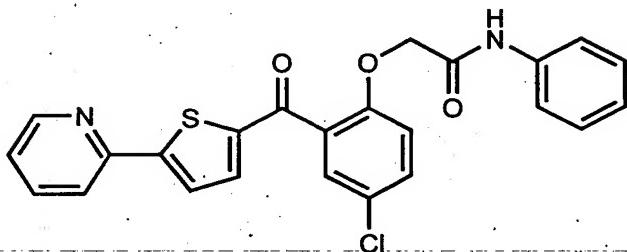
15

**Step B:****15**

To a round-bottom flask equipped with a stir bar and nitrogen on demand were placed 2-bromo-4-chloroanisole (5.97 g, 26.95 mmol) and THF (75 mL). The resulting solution was cooled to -78 °C and n-butyl lithium (19.5 mL of a 1.6 M solution in hexane, 31.2 mmol) was added via syringe. The resulting solution was allowed to stir at -78 °C for 30 min and amide 14 (4.2 g, 24.97 mmol in 15 mL THF), was added via syringe. The mixture was allowed to stir at -78 °C for 30 min, after which time it was allowed to warm to RT and stir for an additional 30 min. The mixture was then poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with

MHz) δ 9.69 (s, 1H), 7.81 (d, J= 9 Hz, 2H), 7.54 (d, J= 3 Hz, 1H), 7.47 (dd, J= 6, 3 Hz, 1H), 7.38 (t, J= 6Hz, 2H), 7.16 (t, J= 6 Hz, 1H), 7.03 (m, 2H), 6.75 (m, 1H), 6.23 (m, 1H), 4.75 (s, 2H), 4.17 (s, 3H).

5    **Example 7**



10    **Step A:**

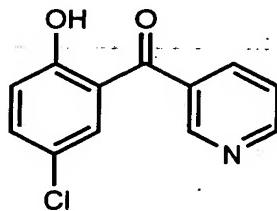
5-(2-pyridyl)thiophene-2-carboxylic acid (2.62 g, 12.77 mmol), oxalyl chloride (1.4 mL, 2.04 g, 16.05 mmol), DMF (0.25 mL) and CH<sub>2</sub>Cl<sub>2</sub> (25 mL) were used according to general procedure V. The acid chloride was used immediately in the next step without any further purification. Into a separate flask equipped with a stir bar and nitrogen on demand were placed N,O-dimethylhydroxylamine hydrochloride (1.63 g, 16.71 mmol), Et<sub>3</sub>N (9 mL, 6.53 g, 64.57 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (25 mL). The resulting solution was cooled to 0 °C, and the acid chloride (in 10 mL of CH<sub>2</sub>Cl<sub>2</sub>) was added dropwise. When the addition was complete, the mixture was allowed to stir at 0 °C for an additional 30 min, and then was allowed to warm to rt and stir for an additional 1h. The mixture was then poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure leaving a white solid (2.69 g, 85%). The product was used in subsequent steps without any further purification. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 8.64 (d, J

and boron tribromide (20 mL of a 1.0 M solution in  $\text{CH}_2\text{Cl}_2$ , 20 mmol) was added via syringe. The resulting dark red mixture was allowed to stir at  $-78^\circ\text{C}$  for 1 h and it was then allowed to warm to rt and stir for an additional 1 h. The mixture was carefully poured over ice water and the resulting two-phase mixture was allowed to stir for 30 min. It was  
 5 then poured into a separatory funnel containing  $\text{CH}_2\text{Cl}_2$  and water. The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure to afford a tan solid (1.32 g, 97%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  11.55 (s, 1H), 8.70 (d,  $J = 6$  Hz, 1H), 8.00 (d,  $J = 3$  Hz, 1H), 7.82 (m, 3H), 7.75 (d,  $J = 3$  Hz, 1H), 7.51 (dd,  $J = 9, 3$  Hz, 1H), 7.34 (m, 1H), 7.08 (d,  $J = 9$  Hz, 1H).

10

**Step D:**

15 Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed phenol **20** (0.13 g, 0.42 mmol), 2'-chloroacetanilide (0.10 g, 0.57 mmol),  $\text{K}_2\text{CO}_3$  (0.29 g, 2.09 mmol) and acetone (10 mL). The resulting mixture was heated to reflux for 18 h, after which time it was allowed to cool to RT and was poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure. The product was purified by flash chromatography using 65:35 hexane/ethyl  
 20 acetate as eluant to afford **17** as a white solid (0.16 g, 85%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  9.34 (s, 1H), 8.70 (d,  $J = 6$  Hz, 1H), 7.80 (m, 3H), 7.68 (m, 3H), 7.55 (dd,  $J = 9, 3$  Hz, 1H), 7.35 (m, 4H), 7.14 (t,  $J = 6$  Hz, 1H), 7.07 (d,  $J = 9$  Hz, 1H), 4.75 (s, 2H).



25

**21****Step A:**

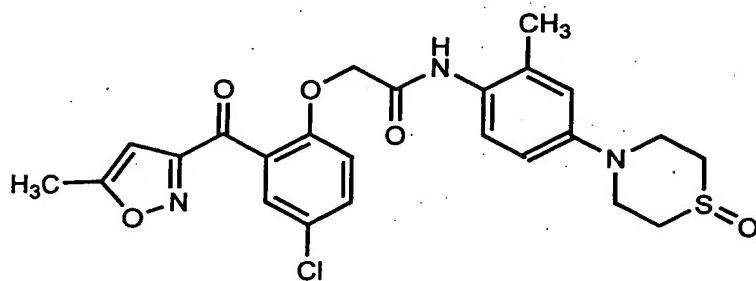
it was allowed to cool to rt. The suspension was then filtered through a pad of celite, which was washed with several portions of  $\text{CH}_2\text{Cl}_2$ . The solvents were removed under reduced pressure to afford a tan solid (6.55 g, 95%). The solid was used in subsequent reactions without any further purification.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  8.94 (d,  $J$ = 3 Hz, 5 H), 8.81 (dd,  $J$ = 6, 3 Hz, 1H), 8.19 (m, 1H), 7.49 (m, 2H), 6.98 (d,  $J$ = 9 Hz, 1H), 3.74 (s, 3H).

### Step C:

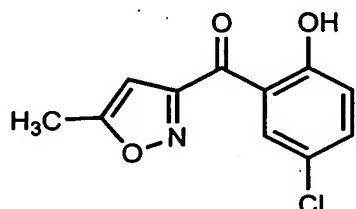
Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed 10 ketone **23** (6.55 g, 26.45 mmol) and  $\text{CH}_2\text{Cl}_2$  (200 mL). The resulting solution was cooled to  $-78^\circ\text{C}$  and boron tribromide (50 mL of a 1.0 M solution in  $\text{CH}_2\text{Cl}_2$ , 50 mmol) was added via syringe. The resulting solution was allowed to stir at  $-78^\circ\text{C}$  for 1 h, after which time it was allowed to warm to rt and stir for an additional 30 min. The mixture was carefully poured over ice water and the resulting two-phase system was stirred for 30 min. 15 It was then poured into a separatory funnel containing water and  $\text{CH}_2\text{Cl}_2$ . The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure to afford **21** as a yellow solid (5.25 g, 85%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  11.77 (s, 1H), = 3 Hz, 1H), 8.90 (dd,  $J$ = 3, 1.5 Hz, 1H), 8.07 (m, 1H), 7.55 (m, 3H), 7.11 (m, 1H).

20

### Example 9:



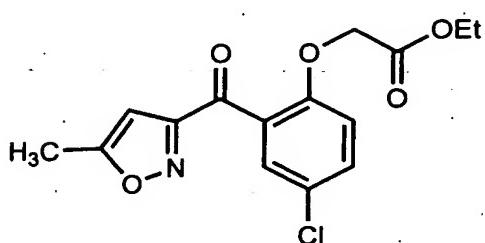
$\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure to provide a white solid (5.37 g, 94%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 400 MHz)  $\delta$  7.51 (d,  $J = 3$  Hz, 1H), 7.42 (dd  $J = 6, 3$  Hz, 1H), 6.92 (d,  $J = 6$  Hz, 1H), 6.45 (s, 1H), 3.76 (s, 3H), 2.49 (s, 3H).

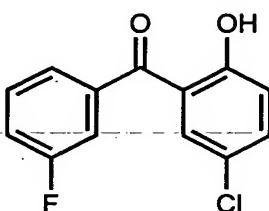
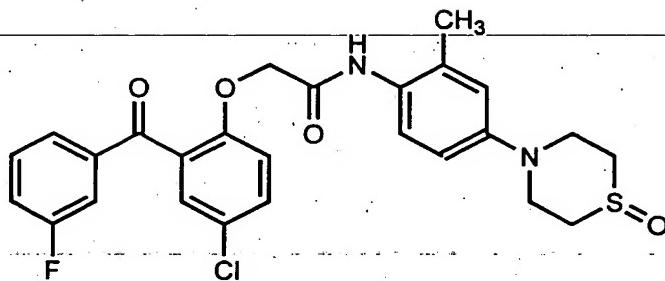


5    **Step C:**

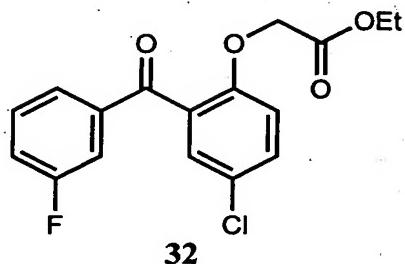
10    Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed ketone **26** (5.36 g, 21.30 mmol) and  $\text{CH}_2\text{Cl}_2$  (100 mL). The solution was cooled to  $-78^\circ\text{C}$  and boron tribromide (40 mL of a 1.0 M solution in  $\text{CH}_2\text{Cl}_2$ ) was added via syringe. The resulting dark red solution was allowed to stir at  $-78^\circ\text{C}$  for 1 h, after which time it was  
15    allowed to warm to RT and stir for an additional 2 h. The mixture was then carefully poured over ice water and the resulting two-phase system was stirred for 30 min. The mixture was then poured into a separatory funnel containing  $\text{Et}_2\text{O}$  and water. The organic layer was collected and was washed with water, brine, dried over  $\text{MgSO}_4$ , filtered and the solvents were removed under reduced pressure to afford a tan solid (5.44 g) which was  
20    used in subsequent reactions without any further purification.

**Step D:**

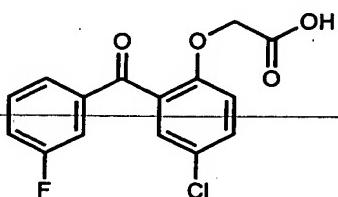


**Step A:**

5      4-Chloroanisole (4.06 g, 28.47 mmol), 3-fluorobenzoyl chloride (4.53 g, 28.57 mmol),  
 AlCl<sub>3</sub> (6.23 g, 46.72 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (100 mL) were used according to general  
 procedure I. The product was purified by flash chromatography using 7:3 hexane/CH<sub>2</sub>Cl<sub>2</sub>  
 as eluant to provide the 31 as a yellow solid (2.60 g, 36%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ  
 10     11.80 (s, 1H), 7.50 (m, 6H), 7.09 (d, J= 9 Hz, 1H).

**Step B:**

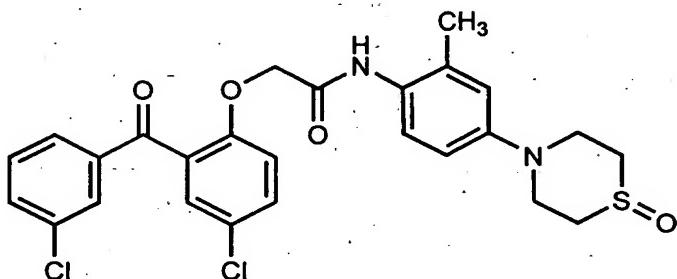
15     Phenol 31 (2.60 g, 10.37 mmol), ethyl bromoacetate (1.3 mL, 11.72 mmol), K<sub>2</sub>CO<sub>3</sub> (7.15  
 g, 51.73 mmol), and acetone (80 mL) were used according to general procedure II. The  
 product was used in subsequent reactions without any further purification.



dried over  $MgSO_4$ , filtered and the solvents were removed under reduced pressure. The product was purified by flash chromatography using 95:5  $CH_2Cl_2/CH_3OH$  as eluant to provide 34 as a white solid (0.117 g, 34%).  $^1H$  NMR ( $DMSO-d_6$ , 300 MHz)  $\delta$  9.39 (s, 1H), 7.71-7.52 (m, 9H), 7.31-7.27 (m, 3H), 4.85 (s, 2H), 2.21 (s, 3H).

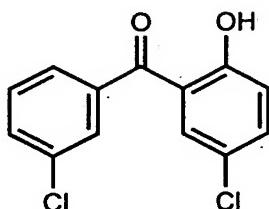
5

Example 12:



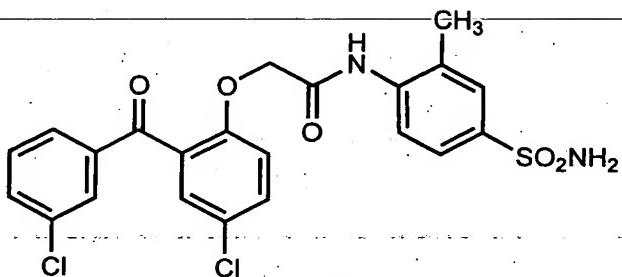
35

10 Step A:



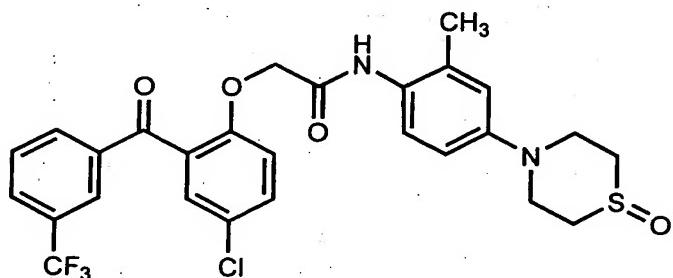
36

4-Chloroanisole (4.02 g, 28.19 mmol), 3-chlorobenzoyl chloride (3.8 mL, 4.94 g, 28.22 mmol),  $AlCl_3$  (5.62 g, 42.15 mmol) and  $CH_2Cl_2$  (75 mL) were used according to general procedure I. The product was purified by flash chromatography using 7:3 hexane/ $CH_2Cl_2$  as eluant to provide 36 as a yellow solid (5.35 g, 71%).  $^1H$  NMR ( $CDCl_3$ , 400 MHz)  $\delta$  1.72 (s, 1H), 7.64 (s, 1H), 7.58 (d,  $J = 8$  Hz, 1H), 7.53-7.44 (m, 4H), 7.03 (d,  $J = 12$  Hz, 1H).



Carboxylic acid **38** (0.229 g, 0.704 mmol), oxalyl chloride (0.2 mL, 2.29 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (4 mL) were used according to general procedure V. Into a separate flask were placed sulfonamide **466** (0.156 g, 0.838 mmol), Et<sub>3</sub>N (0.25 mL, 1.79 mmol) and CH<sub>3</sub>CN (8 mL). The acid chloride (in 2 mL of CH<sub>3</sub>CN) was added dropwise over several minutes. The resulting solution was allowed to stir at 0 °C for 30 min, after which time it was allowed to warm to rt and stir for an additional 5 h. The mixture was then poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure. The product was purified by flash chromatography using 95:5 CH<sub>2</sub>Cl<sub>2</sub>/CH<sub>3</sub>OH as eluant to provide **39** as a white solid (0.110 g, 32%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 9.39 (s, 1H), 7.82–7.53 (m, 9H), 7.30 (m, 3H), 4.84 (s, 2H), 2.20 (s, 3H).

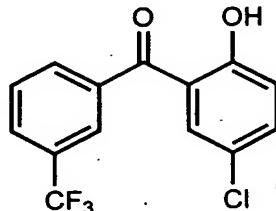
**15 Example 14:**



40

**20 Step A:**

dried over  $MgSO_4$ , filtered and the solvents were removed under reduced pressure to leave a yellow oil, which was used in subsequent reactions without any further purification.



**Step C:**

5

43

Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed 42 (23 mmol) and  $CH_2Cl_2$  (150 mL). The solution was cooled to -78 °C and boron tribromide (35 mL of a 1.0 M solution in  $CH_2Cl_2$ , 35 mmol) was added dropwise over several minutes. The resulting dark mixture was allowed to stir at -78 °C for 30 min, after which time it was allowed to warm to rt and stir for an additional 1h. The mixture was carefully poured over ice and the two-phase mixture was stirred for 30 min. It was then poured into a separatory funnel containing  $CH_2Cl_2$  and water. The organic layer was collected, washed with water, brine, dried over  $MgSO_4$ , filtered and the solvents were removed under reduced pressure to afford a yellow solid (5.04 g, 73%). <sup>1</sup>H NMR ( $CDCl_3$ , 300 MHz) δ 11.76 (s, 1H), 8.25-7.84 (m, 3H), 7.73 (t,  $J$ = 9 Hz, 1H), 7.56-7.52 (m, 2H), 7.12 (d,  $J$ = 9 Hz, 1H).

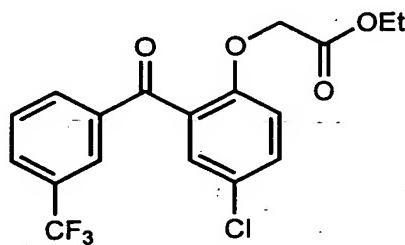
10

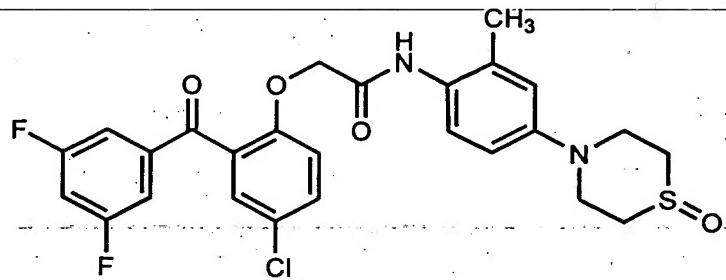
15

**Step D:**

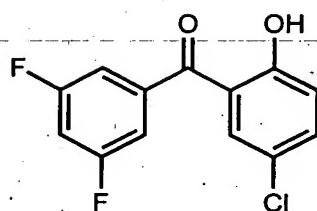
20

44





46

**Step A:**

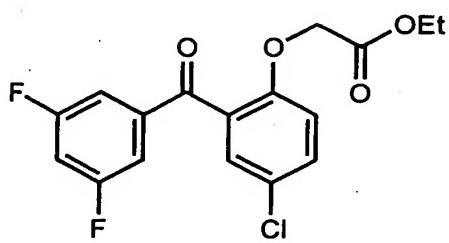
5

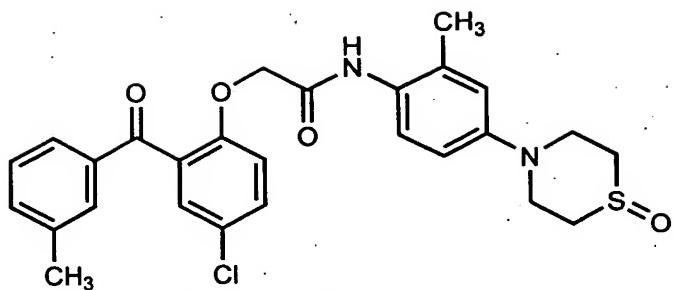
47

4-Chloroanisole (4.12 g, 28.89 mmol), 3,5-difluorobenzoyl chloride (5.0 g, 28.3 mmol), AlCl<sub>3</sub> (5.65 g, 42.37 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (75 mL) were used according to general procedure I. The product was purified by flash chromatography using 7:3 hexane/CH<sub>2</sub>Cl<sub>2</sub> as eluant to provide a yellow solid (2.72 g, 36%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 11.64 (s, 1H), 7.54 (m, 2H), 7.23 (m, 2H), 7.11 (m, 2H).

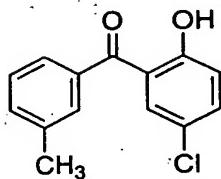
**Step B:**

15





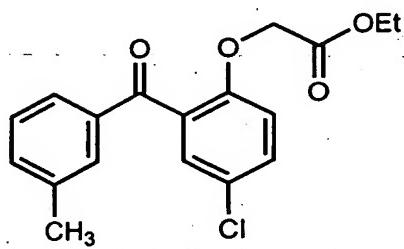
50

**Step A:**

5

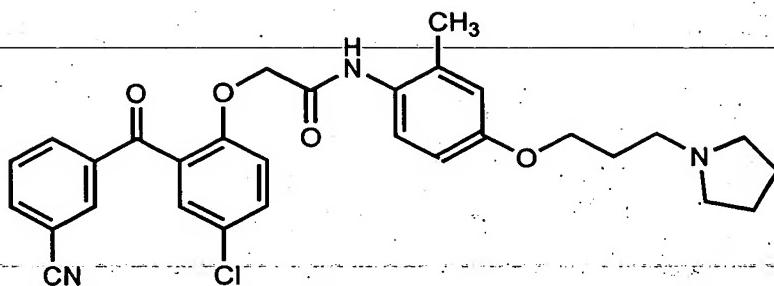
4-Chloroanisole (4.16 g, 29.17 mmol), 3-methylbenzoyl chloride (4.42 g, 28.59 mmol), AlCl<sub>3</sub> (6.12 g, 45.9 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (150 mL) were used according to general procedure I. The product was purified by flash chromatography using 7:3 hexane/CH<sub>2</sub>Cl<sub>2</sub> as eluant to provide 50 as yellow solid (1.54 g, 22%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 400 MHz) δ 11.91 (s, 1H), 7.54 (d, J = 4 Hz, 1H), 7.47-7.39 (m, 5H), 7.02 (d, J = 8 Hz, 1H), 2.44 (s, 3H).

10

**Step B:**

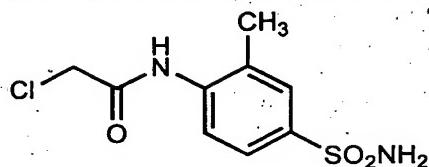
51

15 Phenol 50 (1.54 g, 6.24 mmol), ethyl bromoacetate (0.8 mL, 7.21 mmol), K<sub>2</sub>CO<sub>3</sub> (3.15 g, 22.79 mmol) and acetone (35 mL) were used according to general procedure II. Removal



53

Carboxylic acid **129** (0.316 g, 1.00 mmol), amine **143** (0.241 g, 1.03 mmol), EDAC (0.251 g, 1.31 mmol), HOBr (0.167 g, 1.24 mmol) and DMF (5 mL) were used according to general procedure IV, with the exception that no Et<sub>3</sub>N was used. The product was purified



54

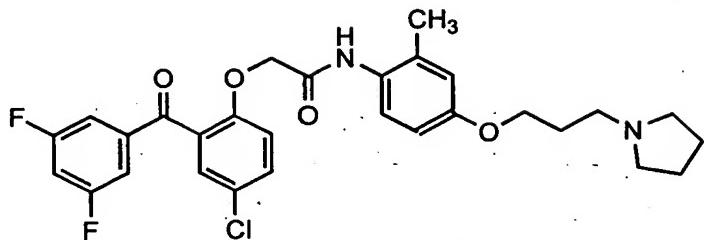
by flash chromatography using 9:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH as eluant to provide **53** as a tan powder (0.082 g, 15%).

10 Into a round-bottom flask were placed aniline **466** (0.246 g, 1.32 mmol), Et<sub>3</sub>N (0.9 mL, 0.65 g, 6.5 mmol), CHCl<sub>3</sub> (5 mL) and CH<sub>3</sub>CN (5 mL). The resulting mixture was cooled to 0 °C and 2-chloroacetyl chloride (0.2 mL, 2.51 mmol) was added dropwise over several minutes. The mixture was allowed to stir at 0 °C for 30 minutes and was then allowed to warm to rt and stir for an additional 30 minutes. The mixture was then poured into a separatory funnel containing H<sub>2</sub>O and ethyl acetate. The organic layer was collected, washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to afford a dark, green oil. Several portions of hexane were added and subsequently removed under reduced pressure to afford **54** as a green solid, which was used without any further purification. <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 9.84 (s, D 1H), 7.69 (m, 3H), 7.31 (s, 2H), 4.38 (s, 2H), 2.31 (s, 3H).

### Example 18

$\delta$  9.39 (s, 1H), 8.33 (d,  $J$ = 3 Hz, 1H), 8.16 (d,  $J$ = 3 Hz, 1H), 7.83-7.64 (m, 5H), 7.39-7.30 (m, 3H), 4.86 (s, 2H), 2.23 (s, 3H).

**Example 20**



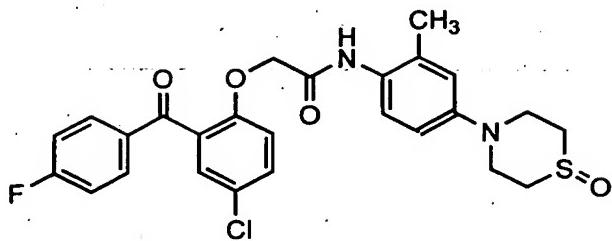
5

57

Acid 49 (0.351 g, 1.07 mmol), amine 143 (0.253 g, 1.08 mmol), EDAC (0.341 g, 1.78 mmol), HOBt (0.193 g, 1.43 mmol) and DMF (7 mL) were used according to general procedure IV, with the exception that no Et<sub>3</sub>N was used. The product was purified by flash chromatography using 9:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH to provide a tan solid (0.09 g, 15%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz)  $\delta$  8.19 (s, 1H), 7.49 (dd,  $J$ = 9, 3 Hz, 1H), 7.42 (d,  $J$ = 9 Hz, 1H), 7.33 (d,  $J$ = 3 Hz, 1H), 7.27 (d,  $J$ = 3 Hz, 1H), 7.19 (m, 1H), 7.01-6.96 (m, 2H), 6.65-6.63 (m, 2H), 4.62 (s, 2H), 4.00-3.96 (t,  $J$ = 6 Hz, 2H), 3.76 (m, 2H), 3.23-3.15 (m, 2H), 2.75 (m, 2H), 2.39-2.12 (m, 6H), 2.09 (s, 3H).

15

**Example 21**



58

filtered and dried to provide 61 as a white solid, which was used without any further purification.

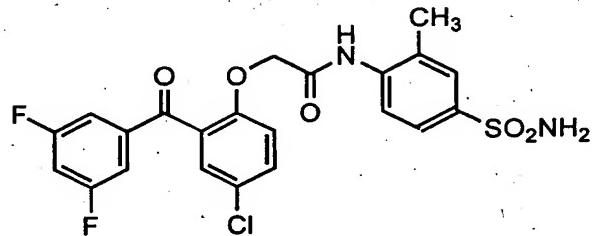
**Step D:**

5

Carboxylic acid 61 (0.237 g, 0.786 mmol), sulfoxide 399 (0.198 g, 0.88 mmol), EDAC (0.285 g, 1.49 mmol), HOBr (0.131 g, 0.97 mmol) and DMF (5 mL) were used according to general procedure IV. The product was purified by flash chromatography using 95:5 CH<sub>2</sub>Cl<sub>2</sub>/CH<sub>3</sub>OH as eluant to provide 58 as a tan solid (0.280 g, 71%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 8.95 (s, 1H), 7.90 (m, 2H), 7.66 (dd, J= 9, 3 Hz, 1H), 7.49 (d, j= 3 Hz, 1H), 7.36 (t, J= 6 Hz, 2H), 7.26 (d, J= 9 Hz, 1H), 7.14 (d, J= 9 Hz, 1H), 6.84 (m, 2H), 4.73 (s, 2H), 3.75 (m, 2H), 3.58 (m, 2H), 2.91 (m, 2H), 2.71 (m, 2H), 2.03 (s, 3H).

10

**Example 22**



15

62

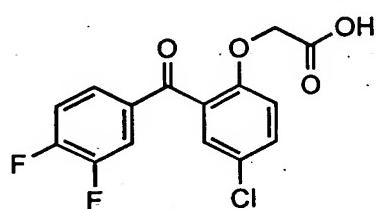
Carboxylic acid 49 (0.123 g, 0.377 mmol), oxalyl chloride (0.1 mL, 1.15 mmol), DMF (2 drops) and chloroform (5 mL) were used to prepare the acid chloride according to general procedure V. The acid chloride, sulfonamide 466 (0.07 g, 0.37 mmol), NaHCO<sub>3</sub> (0.13 g, 1.55 mmol), water (1 mL) and acetone (5 mL) were used according to general procedure VI to afford 62 as a tan solid (0.07 g, 40%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 9.46 (s, 1H), 7.68-7.45 (m, 8H), 7.28 (m, 3H), 4.85 (s, 2H), 2.21 (s, 3H).

20

**Example 23**

Phenol **64** (2.65 g, 9.86 mmol), ethyl bromoacetate (1.20 mL, 10.82 mmol), K<sub>2</sub>CO<sub>3</sub> (5.37 g, 38.85 mmol) and acetone (35 mL) were used according to general procedure II to provide **65** as white solid (3.39 g, 96%) that was used without any further purification.

**5 Step C:**



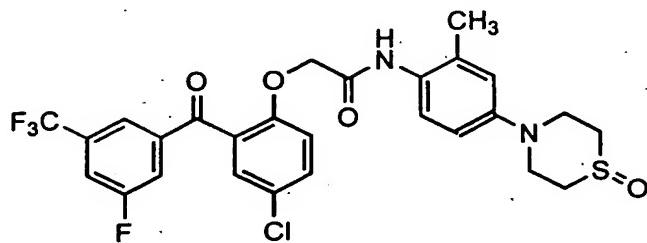
**66**

Ester **65** (3.39 g, 9.56 mmol), lithium hydroxide (0.80 g, 19.07 mmol), water (20 mL), THF (40 mL) and EtOH (20 mL) were used according to general procedure III to provide **66** as a white solid which was used without any further purification.

**Step D:**

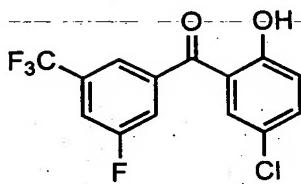
Carboxylic acid **66** (0.146 g, 0.447 mmol), sulfoxide **399** (0.096 g, 0.429 mmol), EDAC (0.183 g, 0.955 mmol), HOBt (0.077 g, 0.569 mmol) and DMF (5 mL) were used according to general procedure IV. The product was purified by flash chromatography using 95:5 CH<sub>2</sub>Cl<sub>2</sub>/CH<sub>3</sub>OH as eluant to provide **63** as a tan solid (0.150 g, 63%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 8.35 (s, 1H), 7.79-7.56 (m, 3H), 7.41 (d, J = 3 Hz, 1H), 7.32 (m, 2H), 7.09 (d, J = 9 Hz, 1H), 6.87 (br s, 1H), 4.73 (s, 2H), 4.04 (m, 2H), 3.58 (m, 2H), 3.02 (m, 4H), 1.62 (s, 3H).

**Example 24**



which time amide **68** (5.04 g, 20.07 mmol) was added dropwise. The mixture was allowed to stir at -78 °C for 30 min, after which time it was allowed to warm to rt and stir for an additional 2 h. The mixture was then poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and was washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure afford **69** as a yellow solid (6.14 g, 92%), which was used in subsequent reactions without any further purification. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 7.84 (s, 1H), 7.68 (d, J= 9 Hz, 1H), 7.58-7.51 (m, 2H), 7.44 (d, J= 3 Hz, 1H), 7.00 (d, J= 9 Hz, 1H), 3.74 (s, 3H).

**10 Step C:**



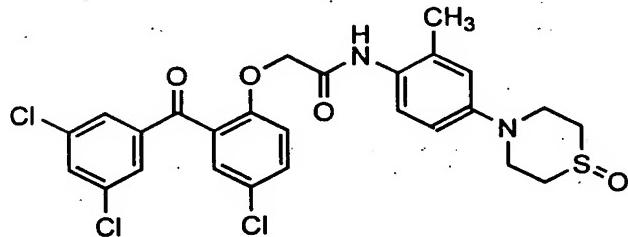
70

15 Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed **69** (6.14 g, 18.46 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (100 mL). The solution was cooled to -78 °C and boron tribromide (50 mL of a 1.0 M solution in CH<sub>2</sub>Cl<sub>2</sub>, 50 mmol) was added dropwise over several minutes. The resulting dark mixture was allowed to stir at -78 °C for 30 min, after which time it was allowed to warm to rt and stir for an additional 1h. The mixture was carefully poured over ice and the two-phase mixture was stirred for 30 min. It was then 20 poured into a separatory funnel containing CH<sub>2</sub>Cl<sub>2</sub> and water. The organic layer was collected, washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to afford **70** as a yellow solid (5.68 g, 96%), which was used without any further purification. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 11.61 (s, 1H), 7.77 (s, 1H), 7.65-7.54 (m, 3H), 7.47 (d, J= 3 Hz, 1H), 7.12 (d, J= 9 Hz, 1H).

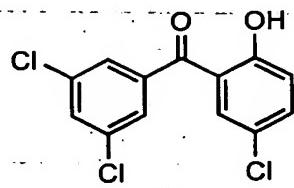
72

Carboxylic acid 105 (0.195 g, 0.65 mmol), 6-aminobenzthiazole (Lancaster, 0.105 g, 0.70 mmol), EDAC (0.23 g, 1.20 mmol), HOBr (0.105 g, 0.78 mmol) and DMF (5 mL) were used according to general procedure IV, with the exception that no Et<sub>3</sub>N was used. The product was purified by flash chromatography using 1:1 hexane/ethyl acetate as eluant to provide 72 as a white solid (0.24 g, 87%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 400 MHz) δ 9.51 (s, 1H), 8.92 (s, 1H), 8.64 (s, 1H), 8.08 (d, J= 8 Hz, 1H), 7.92 (d, J= 8 Hz, 1H), 7.67-7.63 (m, 2H), 7.55-7.50 (m, 3H), 7.42 (s, 1H), 7.04 (d, J= 8 Hz, 1H), 4.73 (s, 2H).

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**Example 26**

73

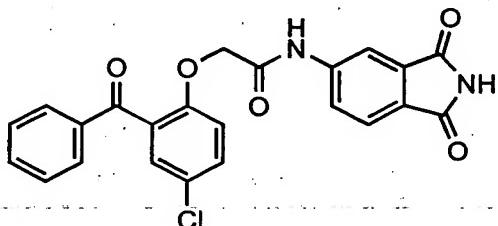
**Step A:**

74

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3,5-Dichlorobenzoyl chloride (5.0 g, 23.87 mmol), 4-chloroanisole (3.40 g, 23.84 mmol), aluminum chloride (5.56 g, 41.70 mmol) and dichloromethane (100 mL) were used according to general procedure I. The product was purified by flash chromatography using 7:3 hexane/dichloromethane to provide 74 as a yellow solid (1.18 g, 16%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 11.62 (s, 1H), 7.65 (s, 1H), 7.56-7.49 (m, 4H), 7.09 (d, J= 9 Hz, 1H).

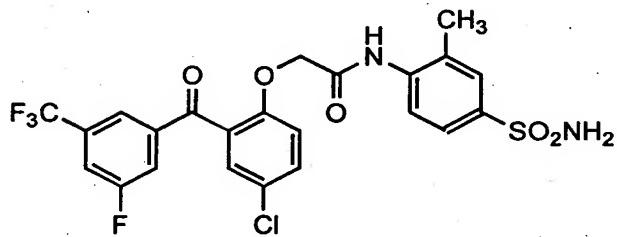
20

**Example 27**

77

Carboxylic acid **105** (0.125 g, 0.417 mmol), 3-aminophthalimide (TCI, 0.062 g, 0.382 mmol), EDAC (0.132 g, 0.689 mmol), HOEt (0.063 g, 0.467 mmol) and DMF (5 mL) were used according to general procedure IV. The product was purified by flash chromatography using 95:5 chloroform/methanol to afford **77** as a white solid (0.038 g, 22%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 10.10 (s, 1H), 8.39 (s, 1H), 8.25 (dd, J = 9, 3 Hz, 1H), 7.97 (d, J = 9 Hz, 2H), 7.80 (d, J = 9 Hz, 1H), 7.73 (t, J = 6 Hz, 1H), 7.63-7.56 (m, 4H), 7.48 (d, J = 3 Hz, 1H), 7.10 (d, J = 9 Hz, 1H), 4.82 (s, 2H).

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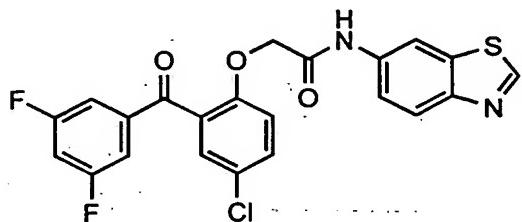
**Example 28**

78

15 Carboxylic acid **71** (11.24 g, 29.84 mmol), oxalyl chloride (3.9 mL, 44.71 mmol), DMF (5 mL) and chloroform (250 mL) were used according to general procedure V to prepare the acid chloride, which was used without further purification. The acid chloride, sulfonamide **466** (5.12 g, 27.49 mmol), NaHCO<sub>3</sub> (11.12 g, 132 mmol), acetone (300 mL) and water (10 mL) were used according to general procedure VI. The product was purified by crystallization from a mixture of acetonitrile/water to provide **78** as a white solid (9.01 g, 60%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 9.47 (s, 1H), 8.05 (d, J = 9 Hz, 1H), 7.93-7.90 (m,

20

77%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  10.18 (s, 1H), 9.30 (s, 1H), 8.50 (s, 1H), 8.26 (s, 1H), 8.13 (d, J= 9 Hz, 1H), 8.05 (t, J= 9 Hz, 2H), 7.75-7.66 (m, 2H), 7.56 (m, 2H), 7.26 (d, J= 9 Hz, 1H), 4.81 (s, 2H).



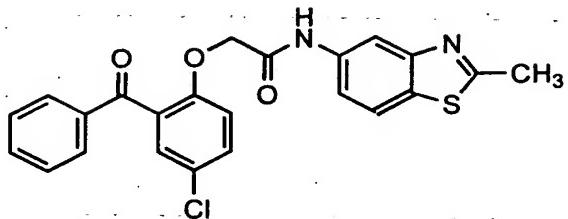
5    **Example 31**

81

Carboxylic acid **49** (0.106 g, 0.324 mmol), 6-aminobenzothiazole (Lancaster, 0.051 g, 0.3393 mmol), EDAC (0.158 g, 0.824 mmol), HOBt (0.0584 g, 0.429 mmol) and DMF (5 mL) were used according to general procedure IV. The product was purified by flash chromatography using 95:5 chloroform/methanol to afford **81** as a white solid (0.105 g, 70%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  10.22 (s, 1H), 9.31 (s, 1H), 8.48 (d, J= 3 Hz, 1H), 8.04 (d, J= 9 Hz, 1H), 7.67 (dd, J= 9, 3 Hz, 1H), 7.59-7.48 (m, 5H), 7.25 (d, J= 9 Hz, 1H), 4.82 (s, 2H).

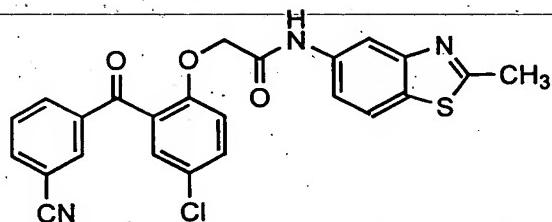
15

**Example 32**



82

Carboxylic acid **105** (0.129 g, 0.43 mmol), oxalyl chloride (0.1 mL, 1.1 5mmol), DMF (4 drops) and dichloromethane (3 mL) were used to prepare the acid chloride according to

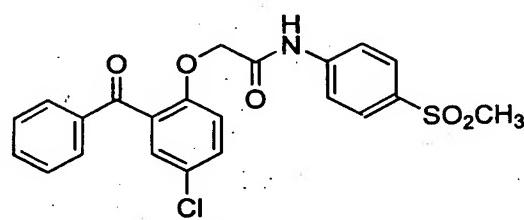


84

Carboxylic acid **129** (0.094 g, 0.298 mmol), oxalyl chloride (0.1 mL, 1.15 mmol), DMF (4 drops) and dichloromethane (5 mL) were used to prepared the acid chloride according to general procedure V. The acid chloride, 5-amino-2-methylbenzthiazole dihydrochloride (0.068 g, 0.287 mmol), NaHCO<sub>3</sub> (0.310 g, 3.69 mmol), water (0.5 mL) and acetone (5 mL) were used according to general procedure VI. The product was purified by flash chromatography using 95:5 chloroform/methanol to afford **84** as a tan solid (0.042 g, 31%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 10.09 (s, 1H), 8.22 (d, J= 9 Hz, 2H), 8.13 (d, J= 6Hz, 1H), 8.06 (d, J= 9 Hz, 1H), 7.94 (d, J= 9 Hz, 1H), 7.75-7.66 (m, 2H), 7.55 (d, J= 3 Hz, 1H), 7.49 (d, J= 3 Hz, 1H), 7.25 (d, J= 6 Hz, 1H), 4.78 (s, 2H), 2.80 (s, 3H).

### Example 35

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85

Carboxylic acid **105** (0.104 g, 0.347 mmol), oxalyl chloride (0.1 mL, 1.15 mmol), DMF (4 drops) and dichloromethane (4 mL) were used to prepare the acid chloride according to general procedure V. The acid chloride, 4-methylsulfonylaniline (0.06 g, 0.350 mmol), NaHCO<sub>3</sub> (0.214 g, 2.55 mmol), water (0.5 mL) and acetone (6 mL) were used according to general procedure VI. The product was purified by flash chromatography using 3:2

Compound 87 (1.26 g, 6.97 mmol), iron powder (1.89 g, 33.84 mmol), concentrated hydrochloric acid (7 mL) and ethanol (35 mL) were added to a round-bottom flask. The mixture was heated to reflux and stirred for 2 h, after which time it was allowed to cool to rt. The mixture was then poured into water and was made basic by the slow addition of solid NaHCO<sub>3</sub>. It was then poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected, washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to afford 88 as a tan solid (0.470 g, 45%). %). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 8.82 (s, 1H), 7.81 (d, J= 9 Hz, 1H), 7.20 (d, J= 3 Hz, 1H), 6.99 (dd, J= 9, 3Hz, 1H), 5.40 (s, 2H).

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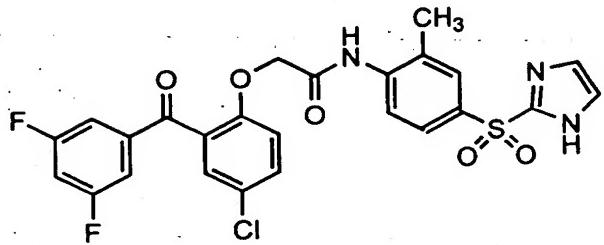
### Step C:

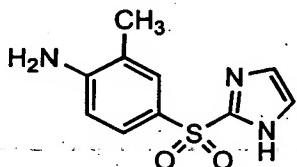
Carboxylic acid 129 (0.125 g, 0.396 mmol), oxalyl chloride (0.1 mL, 1.15 mmol), DMF (4 drops) and dichloromethane (5 mL) were used to prepare the acid chloride according to general procedure V. The acid chloride, amine 88 (0.063 g, 0.419 mmol), NaHCO<sub>3</sub> (0.173 g, 2.06 mmol), water (0.5 mL) and acetone (5 mL) were used according to general procedure VI to afford a yellow solid. The solid was washed with several portions of ether and was dried in vacuo to provide 86 as a yellow solid (0.083 g, 47%).

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### Example 37



**Step C:****92**

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Into a Parr bottle were placed compound 91 (0.092 g, 0.34 mmol), Pd/C (0.01 g, 10% w/w), and ethanol. The bottle was purged with hydrogen (3X) and was finally pressurized to 40 psig. The mixture was allowed to stir at rt for 30 min, after which time the bottle was depressurized and the mixture was filtered through a pad of celite and the solvents were removed under reduced pressure to afford 92 as a yellowish solid (0.083 g, >100% yield), which was used without any further purification. <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 13.54 (br s, 1H), 8.77 (s, 1H), 8.74 (s, 1H), 7.60 (dd, J= 8, 4 Hz, 1H), 7.45 (d, J= 4 Hz, 1H), 7.18 (br s, 2H), 7.09 (d, J= 8 Hz, 1H), 2.05 (s, 3H).

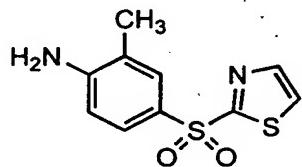
15 **Step D:**

Carboxylic acid 49 (0.100 g, 0.31 mmol), oxalyl chloride (0.1 mL, 1.15 mmol), DMF (4 drops) and chloroform (3 mL) were used to prepared the acid chloride according to general procedure V. The acid chloride, amine 92 (0.065 g, 0.273 mmol), NaHCO<sub>3</sub> (0.134 g, 1.59 mmol), water (0.5 mL) and acetone (4 mL) were used according to general procedure VI to afford a tan solid. The solid was washed with several portions of ether and dried to afford 89 as a tan solid (0.105 g, 62%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 13.74 (s, 1H), 10.26 (s, 1H), 7.70-7.27 (m, 10H), 6.95 (d, J= 9 Hz, 1H), 5.19 (s, 2H), 2.20 (s, 3H).

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Into a round-bottom flask were placed compound 94 (0.103 g, 0.41 mmol), glacial acetic acid (3 mL) and hydrogen peroxide (0.210 g of a 30% w/w solution, 1.85 mmol). The resulting mixture was heated to 85-90 °C for 2 h, after which time it was allowed to cool to rt and was poured into a flask containing a saturated solution of sodium bisulfite. The pH 5 of the mixture was adjusted to pH 7 by the slow addition of solid NaHCO<sub>3</sub> and was then poured into a separatory funnel containing ethyl acetate. The organic layer was collected, washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to afford 95 as a white solid (0.103 g, 89%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 400 MHz) δ 8.10-8.00 (m, 4H), 7.73 (d, J= 4 Hz, 1H), 2.64 (s, 3H).

10

**Step C:**

96

15 Into a Parr bottle were placed compound 95 (0.074 g, 0.34 mmol), Pd/C (0.018 g, 10% w/w), and ethanol (2 mL). The bottle was purged with hydrogen (3X) and was finally pressurized to 45 psig. The mixture was allowed to stir at rt for 30 min, after which time the bottle was depressurized and the mixture was filtered through a pad of celite and the solvents were removed under reduced pressure to afford 96 as a yellow oil, which was 20 used without any further purification. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 7.94 (d, J= 3 Hz, 1H), 7.87 (d, J= 9 Hz, 1H), 7.74 (s, 1H), 7.65 (d, J= 3 Hz, 1H), 7.31 (d, J= 9 Hz, 1H), 5.81 (br s, 2H), 2.13 (s, 3H).

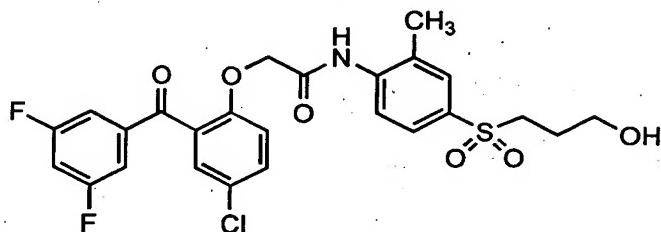
**Step D:**

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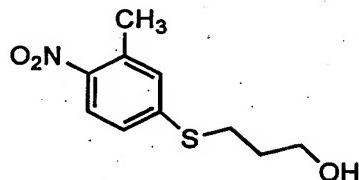
Carboxylic acid 49 (0.104 g, 0.31 mmol), oxalyl chloride (0.6 mL of a 2.0 M solution in dichloromethane, 1.2 mmol), DMF (4 drops) and chloroform (4 mL) were used to prepared the acid chloride according to general procedure V. The acid chloride, amine 96

## 98

Carboxylic acid **49** (0.112 g, 0.343 mmol), oxalyl chloride (0.1 mL, 1.15 mmol), DMF (4 drops) and chloroform (3 mL) were used to prepare the acid chloride according to general procedure V. The acid chloride, the aniline (prepared according to the method of Brown, 5 E.V., *Journal of Organic Chemistry*, 42(19), 3208-3209, 1977), 0.050 g, 0.312 mmol), NaHCO<sub>3</sub> (0.137 g, 1.63 mmol), water (0.5 mL) and acetone (6 mL) were used according to general procedure VI to provide **98** as a yellow solid (0.064 g, 44%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 10.22 (s, 1H), 8.20 (s, 1H), 7.95 (d, J = 9 Hz, 1H), 7.72 (d, J = 9 Hz, 1H), 7.69-7.47 (m, 7H), 7.37 (s, 1H), 7.23 (d, J = 9 Hz, 1H), 4.81 (s, 2H).

10 **Example 41**

## 99

**Step A:**

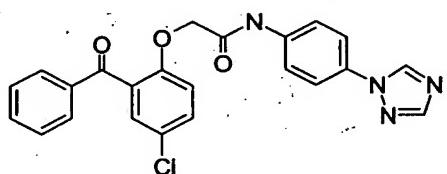
15

**100**

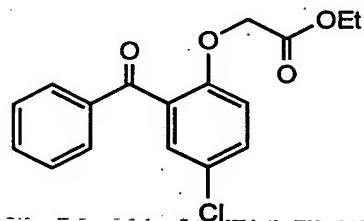
Into a round-bottom flask were placed 5-fluoro-2-nitrotoluene (5.0 g, 32.2 mmol), K<sub>2</sub>CO<sub>3</sub> (15.34 g, 111 mmol), 3-mercaptopropanol (3.2 mL, 37 mmol) and DMF (30 mL). The resulting mixture was allowed to stir at rt for 16 h, after which time it was poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected and washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to afford **100** as thick, yellow oil, which was used without any further purification.

**Step D:**

Carboxylic acid **49** (0.302 g, 0.924 mmol), oxalyl chloride (0.15 mL, 1.72 mmol), DMF (4 drops) and chloroform (10 mL) were used to prepare the acid chloride according to general procedure V. The acid chloride, amine **102** (0.190 g, 0.86 mmol), NaHCO<sub>3</sub> (0.323 g, 4.16 mmol), water (0.5 mL) and acetone (10 mL) were used according to general procedure X to provide **99** as a tan solid (0.326 g, 70%).

**Example 43:**

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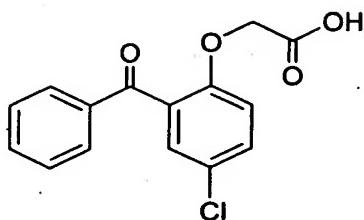
**103****Step A:**

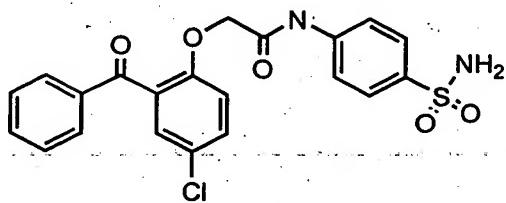
15

**104**

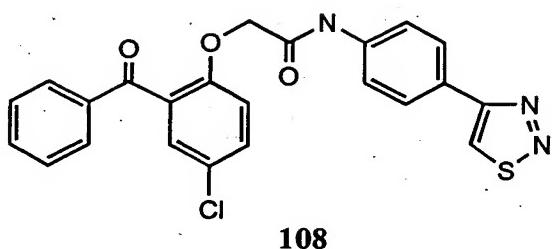
This reaction was run according to general procedure II using 5-chloro-2-hydroxybenzophenone (15 g, 64 mmol), ethyl bromoacetate (7.7 mL, 71 mmol) potassium carbonate and (44 g, 320 mmol). A 96% yield of **104** was obtained as a white solid. <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 1.8 (t, 3H), 4.1 (q, 2H), 4.8 (s, 2H), 7-7.8 (m, 8H).

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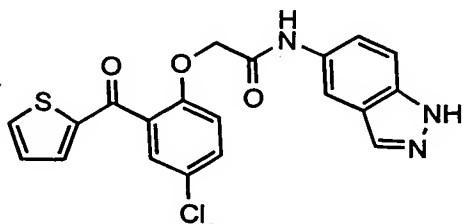
**Step B:**

**Example 45:**

Following the procedure described for the synthesis of **103** and using sulfanilamide, a 6% yield of **107** was obtained as a white solid after purification by flash column chromatography on silica gel with 20% acetone in methylene chloride.  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  4.7 (s, 2H), 6.82 (m, 2H), 7.1-7.8 (m, 12H), 10.1 (s, 1H).

**Example 46:**

Following the procedure described for the synthesis of **103** and using 4-(4-aminophenyl)-1,2,3-thiadiazole as the aniline, a 20% yield of **108** was obtained as a gray solid.  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  4.7 (s, 2H), 7.2 (d, 1H), 7.4-8.1 (m, 11H), 9.41 (s, 1H), 10.0 (s, 1H).

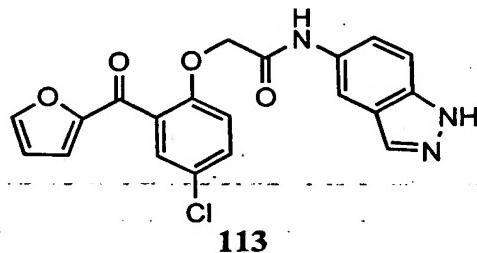
**Example 47:****Step A:**

Following the procedure described in general procedure III, a 22% yield of **112** was obtained as a solid. <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 4.7 (s, 2H), 7.05 (d, 1H), 7.18 (t, 1H), 7.41 (d, 1H), 7.42-7.6 (m, 2H), 8.06 (d, 1H).

**Step D:**

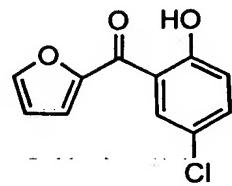
This reaction was run according to general procedure IV using **112** (0.14 g, 0.43 mmol), HOBT (0.06 g, 0.43 mmol), 5-aminoindazole(0.06 g, 0.43 mmol), EDAC (0.08 g, 0.43 mmol) and triethylamine (0.12 mL, 0.86 mmol). A 23% yield of **109** was obtained after purification by flash column chromatography on silica gel with 5% methanol in methylene chloride. <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 4.8 (s, 2H), 7.1-7.3 (m, 2H), 7.32 (d, 1H), 7.46 (d, 1H), 7.48 (s, 1H), 7.56 (d, 1H), 7.7 (d, 1H), 7.98 (s, 1H), 8.04 (s, 1H), 8.1 (d, 1H), 9.8 (s, 1H), 13 (s, 1H).

**Example 48:**



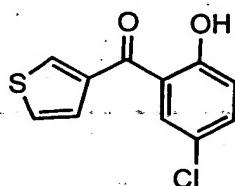
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**Step A:**



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116

**Step A:**

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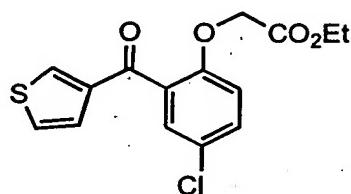
117

A mixture of 3-thiophenecarboxyl chloride (3.58 g, 28 mmol) and thionyl chloride (15 mL) was refluxed for 3 h. The reaction mixture was concentrated and further dried in vacuo. The resultant concentrate was added to a suspension of aluminum chloride (7.61g, 56 mmol) and p-chloroanisole (3.41 mL, 28 mmol). The suspension was heated to reflux for 24 h. Water was slowly added to the reaction mixture and this aqueous mixture was extracted with first methylene chloride, then ethyl acetate. The organic solutions were combined and dried over  $\text{MgSO}_4$ . After solvent removal, the crude product was purified by flash column chromatography on silica gel with methylene chloride/hexane (1:1). This gave 0.13 g (2%) of 117 as oil.  $^1\text{H}$  NMR ( $\text{DMSO-d}_6$ , 300 MHz)  $\delta$  7 (d, 1H), 7.3-7.5 (m, 3H), 7.6-7.7 (m, 1H), 8.2 (m, 1H), 10.4 (s, 1H).

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15

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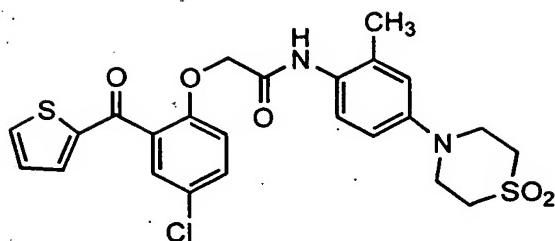
**Step B:**

20

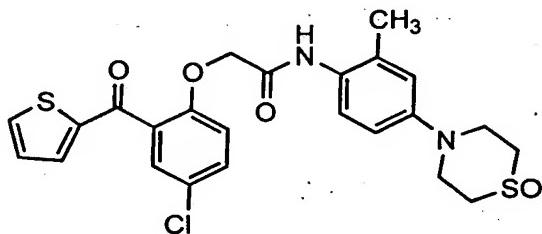
Following general procedure II, a 45% yield of 118 was obtained as oil.  $^1\text{H}$  NMR ( $\text{DMSO-d}_6$ , 300 MHz)  $\delta$  1.1 (t, 3H), 4.08 (q, 2H), 4.8 (s, 2H), 7.07 (d, 1H), 7.38 (d, 1H), 7.44 (d, 1H), 7.49 (dd, 1H), 7.6 (dd, 1H), 8.11 (d, 1H).

25

**Step C:**

**121**

Following general procedure IV using 4-morpholinesulfonyl-2-methylaniline, a 26% yield  
5 of **121** was obtained as a white solid after flash column chromatography on silica gel with  
20% methanol in methylene chloride.  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  3.1 (br s, 4H), 3.7  
(s, 4H), 4.8 (s, 2H), 7 (d, 2H), 7.2-7.3 (m, 2H), 7.43 (d, 2H), 7.54 (d, 1H), 7.6 (dd, 1H), 7.7  
(d, 1H), 8.2 (d, 1H), 9.8 (s, 1H).

10    **Example 52:****122**

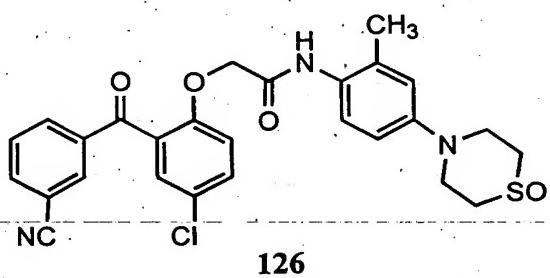
Following general procedure IV using 4-morpholinesulfonyl-2-methylaniline, a 24% yield  
15 of **122** was obtained as a white solid after flash column chromatography on silica gel with  
5% methanol in methylene chloride.  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  2.6-2.8 (m, 2H),  
2.9 (t, 2H), 3.5-3.6 (m, 2H), 3.7 (t, 2H), 4.8 (s, 2H), 7 (d, 2H), 7.2-7.3 (m, 2H), 7.43 (d,  
2H), 7.54 (d, 1H), 7.6 (dd, 1H), 7.7 (d, 1H), 8.2 (d, 1H), 9.8 (s, 1H).

20    **Example 53:**

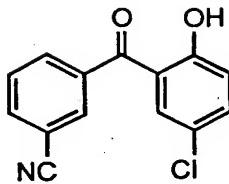
Following the procedure described for the synthesis of compound 103, a 42% yield 125 was obtained as a white solid after flash column chromatography on silica gel with 3% methanol in methylene chloride.  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  2.2 (s, 3H), 4.8 (s, 2H), 7.1-7.3 (m, 3H), 7.5 (d, 1H), 7.5-7.7 (m, 5H), 7.73 (d, 1H), 8.1 (d, 1H), 9.3 (s, 1H).

5

**Example 56:**

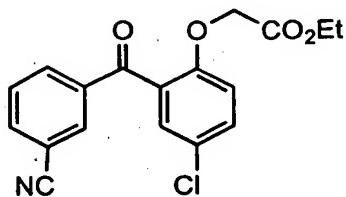


10 **Step A:**



Following general procedure I, a 9% yield of 127 was obtained after flash column chromatography on gel with 30% hexane in methylene chloride.  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  6.97 (d, 1H), 7.38 (s, 1H), 7.42 (d, 1H), 7.7 (t, 1H), 7.98 (d, 1H), 8-8.1 (m, 2H), 10.4 (s, 1H).

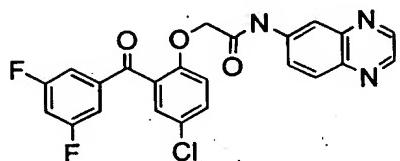
**Step B:**



20 Following general procedure II, a quantitative yield of 128 was obtained as oil that was used in the following reaction without any additional purification.

MS (ES(+)): m/z 443.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  9.85 (s, 1H), 9.66 (s, 1H), 8.32 (s, 1H), 7.79 (m, 2H), 7.57 (dd, 1H), 7.4 (m, 3H), 7.15-7.05 (m, 2H), 4.79 (s, 2H).

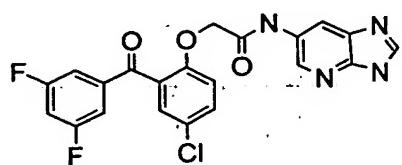
**Example 58:**



131

Acid 49 (0.1 g, 0.3 mmol), was converted to the acid chloride by reaction with oxalyl chloride (0.1 mL, 0.8 mmol) in dichloromethane (5 mL) and 1 drop of DMF (Aldrich, Sure Seal). The reaction was stirred at rt for 1 h. The solvent was removed in vacuo. The title compound was prepared by addition of the acid chloride to 6-aminoquinoxaline (0.045 g, 0.3 mmol; prepared by the method of Case, F. H. and Brennan, J. A., JACS, 1959, 81, 6297) and sodium bicarbonate (0.2 g, 2.2 mmol) in acetone (10 mL) and water (1 mL) by general procedure VI. The product was isolated by chromatography on silica gel eluted with chloroform/methanol (95:5, v/v) in 15% yield. MS (ES(+)): m/z 454.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  9.78 (s, 1H), 8.82 (s, 1H), 8.76 (s, 1H), 8.64 (s, 1H), 8.18 (dd, 1H), 8.09 (d, 1H), 7.56 (dd, 1H), 7.6 (m, 3H), 7.15-7.05 (m, 2H), 4.79 (s, 2H).

**Example 59:**

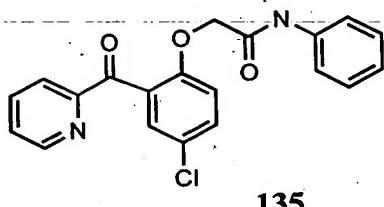


132

Acid 49 (0.1 g, 0.3 mmol), was converted to the acid chloride by reaction with oxalyl chloride (0.1 mL, 0.8 mmol) in dichloromethane (5 mL) and 1 drop of DMF (Aldrich, Sure Seal). The reaction was stirred at rt for 1 h. The solvent was removed in vacuo. The title compound was prepared by addition of the acid chloride to 6-amino-1H-imidazo[4,5-b]pyridine (0.04 g, 0.3 mmol; which can be prepared by the method of Brooks, W. and Day, A. R., J. Heterocyclic Chem., 1969, 6(5), 759) and sodium bicarbonate (0.2 g, 2.2

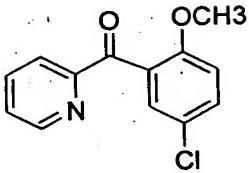
Compound 133 (50 mg, 133 mmol) and Raney-Nickel catalyst (Aldrich, 45 mg, 90% by weight) were added to ethanol (30 mL) and placed on a Parr hydrogenator at 50-psig hydrogen pressure. Additional catalyst (100 mg) was added at 1 h intervals. After 3 h, the catalyst was filtered and the solvents removed in vacuo. The product was purified by chromatography on silica gel eluted with chloroform/methanol (98:2) to obtain 38.6 mg (112 mmol, 84% yield). MS (ES(+)): m/z 347. <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 9.06 (s, 1H), 7.90 (d, 2H), 7.60 (m, 3H), 7.48 (m, 2H), 7.30 (t, 2H), 7.09 (t, 1H), 6.90 (d, 1H), 6.84 (dd, 1H), 6.74 (d, 1H), 4.59 (s, 2H), 3.62 (br s, 2H).

10    **Example 62:**



Step A:

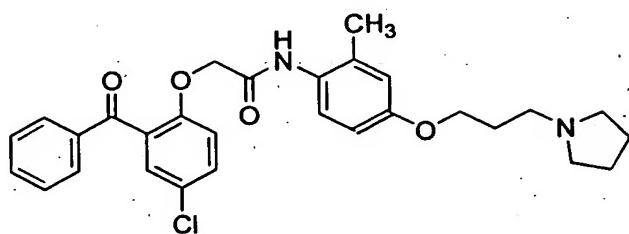
15



2-Bromo-4-chloroanisole (24.4 g, 0.11 mol) was added dropwise to a stirred suspension of magnesium (2.7 g, 0.11 mol) in diethyl ether (150 mL) containing a crystal of iodine. The mixture was heated to reflux for 2 h. A solution of 2-cyanopyridine (11.4 g, 0.11 mol) in diethyl ether (100 mL) was added dropwise and the resulting suspension (yellowish-tan precipitate formed) was refluxed for 2 h, cooled to rt and poured into cold 2N HCl (300 mL). The diethyl ether layer was separated and discarded. The aqueous layer was made basic by addition of 50% aq NaOH and extracted with ether (4 x 300 mL). The combined ether extracts were washed with water, dried over sodium sulfate, and evaporated to give a brown solid. The product was purified by chromatography on silica gel eluted with ethyl acetate/hexane (1:3) to give 10.9 g, in 40% yield. MS (ES<sup>+</sup>) m/z: 248.0 (M+1, 85%), 270

acetonitrile (2 mL) and added to the acid chloride solution. The reaction was stirred at rt for 3 h. A precipitate formed and was filtered. The reaction solvent was removed in vacuo. The product was purified by chromatography on silica gel eluted with hexane/ethyl acetate (3:1, v/v). The product containing fractions were combined and the solvents removed in vacuo to provide a 50% yield. MS (APCI(+)): m+Na/z 404.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  9.85 (s, 1H), 7.85 - 7.0 (m, 13H), 4.95 (s, 2H).

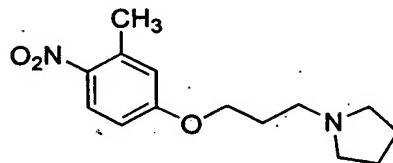
**Example 64:**



138

10

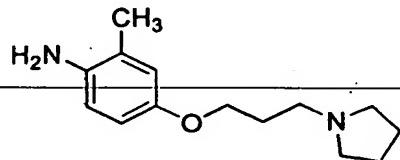
**Step A:**



139

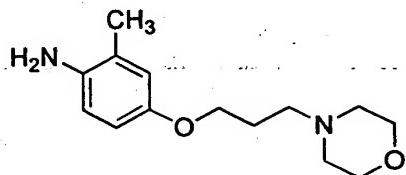
4-(3-bromo-propoxy)-2-methyl-1-nitro-benzene (8.0 g, 29.2 mmol, which can be prepared according to the method found in Patent; Wellcome Foundation; GB 982572; 1960; Chem. Abstr.; EN; 63; 2928b; 1965), pyrrolidine (92.5 mL, 29.2 mmol) and  $\text{K}_2\text{CO}_3$  (5.0 g, 35 mmol) were mixed together in DMF (30 mL) at rt for 16 h. The reaction mixture was filtered and the solvents were removed under reduced pressure to leave an oil and was dissolved in  $\text{CH}_2\text{Cl}_2$ , washed with aqueous NaOH (1N), water, dried and the solvents were removed under reduced pressure. The product was purified by flash chromatography using 95:5 dichloromethane/methanol as eluant to afford 139 as an orange oil (7.5 g, 97%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  1.84 (m, 4H), 2.06 (ddd, 2H), 2.57 (m, 6H), 2.58 (s, 3H), 4.14 (t, 2H), 6.84 (m, 3H), 8.10 (d, 1H).

25 **Step B:**



oil (5.1 g, 100%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  2.02 (ddd, 2H), 2.38-2.56 (m, 6H), 2.64 (s, 3H), 3.73 (m, 4H), 4.11 (t, 2H), 6.81 (m, 2H), 8.09 (d, 1H).

**Step B:**



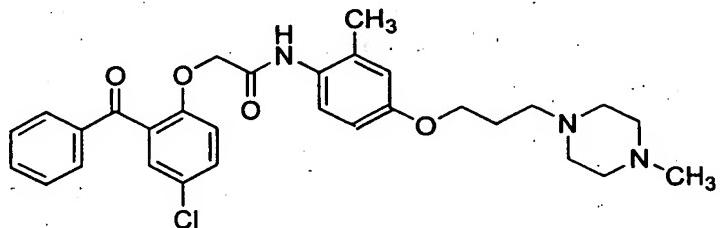
143

Compound 142 (5.1 g, 18.2 mmol) was used in the same manner as that to prepare compound 140. Amine 143 was obtained as an oil (4.3 g, 95%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  1.94 (ddd, 2H), 2.19 (s, 3H), 2.49-2.54 (m, 6H), 3.39 (br s, 1H), 3.75 (m, 4H), 10 3.96 (t, 2H), 6.64-6.70 (m, 3H).

**Step C:**

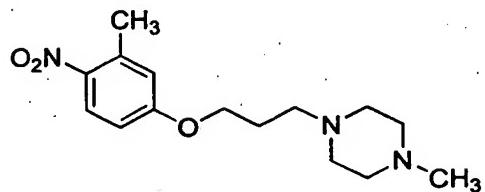
Carboxylic acid 105, amine 143, HOEt, EDAC, triethylamine, and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol to afford 141 as an oil (1.3 g, 67%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  1.98 (ddd, 2H), 2.11 (s, 3H), 2.48-2.56 (m, 6H), 3.75 (m, 4H), 4.02 (t, 2H), 4.68 (s, 2H), 6.6-7.37 (m, 9H), 7.86 (d, 2H), 8.11 (s, 1H).

**Example 66:**



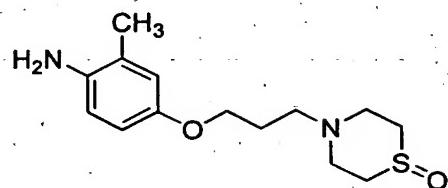
144

**Step A:**



**147**

4-(3-bromo-propoxy)-2-methyl-1-nitro-benzene, and thiomorpholine-1-oxide (5.0 g, 18.2 mmol, which can be prepared according to Nachtergaelle, Willy A.; Anteunis, Marc J. O.; Bull.Soc.Chim.Belg.; EN; 89; 7; 1980; 525-536) were used in the same manner as to 5 prepare compound **139**. Compound **147** was obtained as an oil (2.1 g, 37%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  2.05 (ddd, 2H), 2.65 (s, 3H), 2.63 (t, 2H), 2.65-3.20 (m, 8H), 4.12 (t, 2H), 6.82 (m, 2H), 8.10 (s, 1H).

**Step B:**

10

**148**

Compound **147** (2.1 g, 6.7 mmol) was used in the same manner as that to prepare compound **140**. Amine **148** was obtained as an oil (2.1 g, 98%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  1.84 (ddd, 2H), 2.15 (s, 3H), 2.58 (t, 2H), 2.65-3.25 (m, 10H), 3.84 (t, 2H), 6.28 (m, 3H). 15

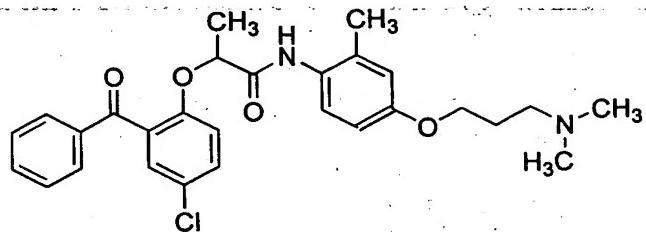
**Step C:**

20 Carboxylic acid **105**, amine **148**, HOBr, EDAC, triethylamine, and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol to afford **146** as an oil (0.7 g, 32%).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$  1.95 (ddd, 2H), 2.71 (s, 3H), 2.63 (t, 2H), 2.65-3.20 (m, 8H), 4.00 (t, 2H), 4.67 (s, 2H), 6.72 (s, 2H), 7.03 (d, 2H), 7.38-7.85 (m, 6H), 7.85 (m, 2H), 8.15 (s, 1H). 25

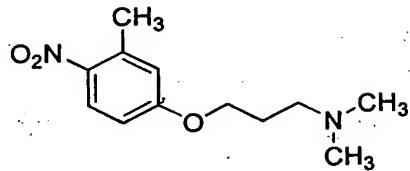
**Example 68:**

using 95:5 dichloromethane/methanol to afford **149** as an oil (1.1 g, 51%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 1.27 (ddd, 2 H), 2.18 (s, 3H), 3.80 (t, 2H), 4.18 (t, 2H), 4.63 (s, 2H), 6.60-7.62 (m, 8H), 7.82 (d, 2H), 8.18 (s, 1H).

**5 Example 69:**

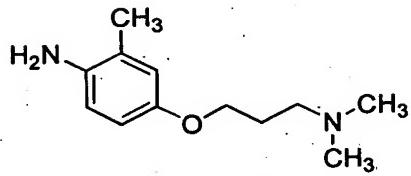
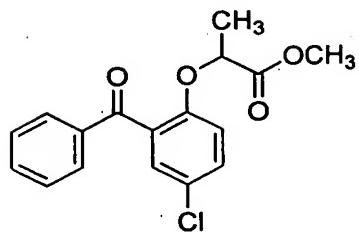
**152**

**Step A:**

**153**

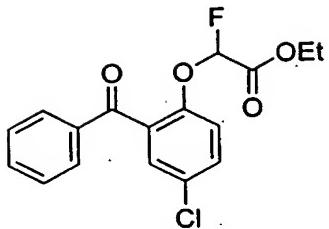
10

**Step B:**

**154**

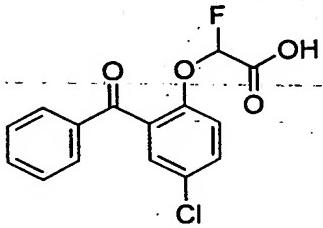
**15 Step C:**

157

**Step A:**

158

- 5 A mixture of 5-chloro-2-hydroxybenzophenone (6.3 g, 27 mmol) ethyl bromofluoroacetate,  $K_2CO_3$  (4.5 g, 32 mmol) and DMF (50 mL) combined and the reaction mixture was allowed to stir at 80 °C for 24 h. The mixture was then filtered, and poured into a separatory funnel containing ethyl acetate and water. The organic layer was collected, washed with water, brine, dried over  $MgSO_4$ , filtered and the solvents were removed under reduced pressure to afford 158 as an oil (7.0 g, 77%).  $^1H$  NMR ( $CDCl_3$ , 300 MHz) δ 1.22 (t, 3H), 4.17 (q, 2H), 5.66 (d, 1H), 5.87 (d, 1H), 7.19-8.82 (m, 8H).
- 10

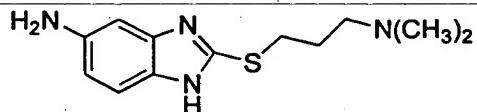
**Step B:**

159

- 15 Ester 158, water, and ethanol (150 mL) were used according to general procedure III, except that sodium hydroxide (5 mL of a 5N aqueous solution) was used in place of lithium hydroxide. The solvents were removed under reduced pressure to afford 159 as white crystals (5.4 g, 84%).  $^1H$  NMR ( $CDCl_3$ , 300 MHz) δ 5.85 (d, 1H), 6.05 (d, 1H), 7.89 (m, 8H).

20

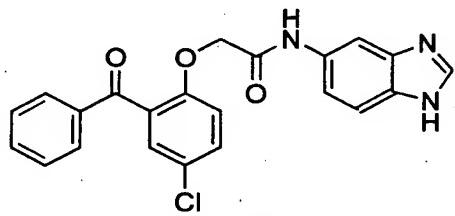
**Step C:**

**Step B:****162**

Into a stirred Parr bottle were placed compound **161** (1.50 g, 5.36 mmol), Pd/C (0.15 g, 5% w/w), and ethanol (300 mL). The bottle was pressurized to 5 atm. with hydrogen gas and the mixture was allowed to stir at rt for 3 h. The mixture was then filtered through a pad of celite and the solvents were removed under reduced pressure to afford **162** as an orange oil (0.80 g, 58%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 1.91 (ddd, 2H), 2.27 (s, 6H), 3.18 (t, 2H), 3.47 (br.s, 2H), 3.68 (br s, 2H), 6.54 (dd, 1H), 6.71 (s, 1H), 7.26 (dd, 1H), 8.27 (s, 1H).

**Step C:**

Carboxylic acid **105**, amine **162**, EDAC, HOBr, and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol as eluant to afford **160** as white crystals (0.24 g, 14%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 2.05 (ddd, 2H), 2.48 (s, 6H), 2.96 (t, 2H), 3.20 (br s, 2H), 4.62 (s, 2H), 5.22 (s, 1H), 6.86-8.20 (m, 11H), 9.00 (s, 1H).

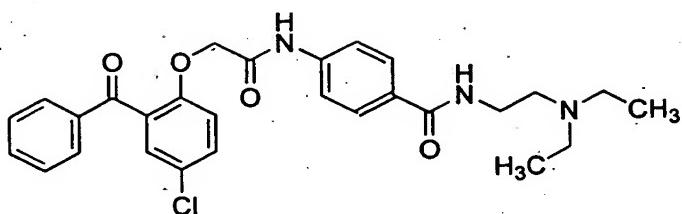
**Example 72:****163**

20

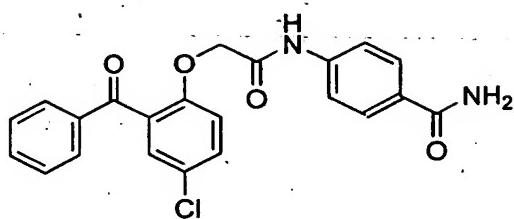
Carboxylic acid **105**, 5-aminobenzimidazole, HOBr, EDAC and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol to afford **163** as white crystals (0.28 g, 35%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 4.66 (s, 2H), 6.97-8.16 (m, 11H), 9.11 (s, 1H), 10.1 (br s, 1H).

**166**

Carboxylic acid **105**, 5-aminobenztriazole, HOt, EDAC, and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol to afford **166** as white crystals (0.75 g, 91%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 4.79 (s, 2H), 7.06-8.61 (m, 11H), 9.81 (s, 1H), 12.60 (br s, 1H).

**Example 76:****167**

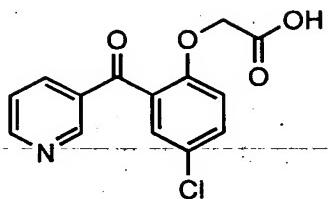
Carboxylic acid **105**, N1-[2-(diethylamino)ethyl]-4-aminobenzamide, HOt, EDAC, and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol to afford **167** as white crystals (0.12 g, 12%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 1.21 (t, 6H), 2.83 (q, 4H), 2.90 (dd, 2H), 3.66 (dd, 2H), 4.73 (s, 2H), 7.04-7.95 (m, 13H), 9.43 (s, 1H).

**Example 77****168**

Carboxylic acid **105**, 4-aminobenzamide, HOt, EDAC, and DMF were used according to general procedure IV. The product was purified by flash chromatography using 95:5 dichloromethane/methanol to afford **168** as white crystals (0.13 g, 13%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 4.75 (s, 2H), 5.34 (s, 2H), 7.06-7.97 (m, 12H), 9.53 (s, 1H).

(0.79 mL, 1.18 g, 7.1 mmol) and acetone (150 mL) were used according to general procedure II to provide 171 as an oil (4.0 g, >100%). The product was used in the next step without any further purification.  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.97 (d,  $J$ = 1.6 Hz, 1H), 8.75 (d,  $J$ = 4 Hz, 1H), 8.18 (d,  $J$ = 7.6 Hz, 1H), 7.43 (m, 3H), 6.78 (d,  $J$ = 8.8 Hz, 1H), 5 4.50 (s, 2H), 4.17 (m, 2H), 1.20 (m, 3H).

### Step B:



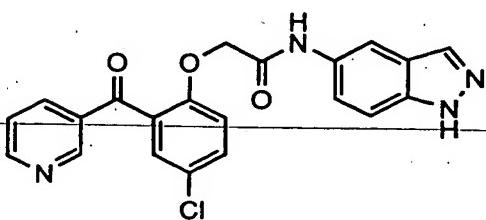
172

Ester 171 (4.0 g, 12.5 mmol), THF (25 mL), water (12 mL), EtOH (12 mL) and LiOH (1.32 g, 31.5 mmol) were used according to general procedure III. Treatment of the resulting yellow gel with ether provided 172 (1.09 g, 29%) as a pale yellow solid. The product was used in the next reaction without any further purification.  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  8.85 (d,  $J$ = 2 Hz, 1H), 8.75 (d,  $J$ = 4.8 Hz, 1H), 8.10 (d,  $J$ = 8 Hz, 1H), 15 7.56 (m, 2H), 7.47 (d,  $J$ = 2.8 Hz, 1H), 7.10 (d,  $J$ = 8.8 Hz, 1H), 4.82 (s, 2H).

### Step C:

Carboxylic acid 172 (0.10 g, 0.34 mmol), amine 399 (0.076 g, 0.34 mmol), HOBr (0.046 g, 0.34 mmol), EDAC (0.19 g, 0.34 mmol),  $\text{Et}_3\text{N}$  (0.1 mL, 0.68 mmol) and anhydrous DMF (5 mL) were used according to general procedure IV. Treatment of resulting oil with diethyl ether provided 170 (0.036 g, 21 %) as a pale yellow solid:  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  8.99 (s, 1H), 8.88 (s, 1H), 8.75 (s, 1H), 8.10 (d,  $J$ = 7.6 Hz, 1H), 7.63 (d,  $J$ = 8.8 Hz, 1H), 7.49 (m, 2H), 7.20 (d,  $J$ = 8.8 Hz, 1H), 7.05 (d,  $J$ = 8.8 Hz, 1H), 6.81 (s, 1H), 6.75 (d,  $J$ = 8.8 Hz, 1H), 4.67 (s, 2H), 3.69 (m, 2H), 3.51 (m, 2H), 2.86 (m, 2H), 2.63 (m, 2H), 1.96 (s, 3H).

### Example 80:

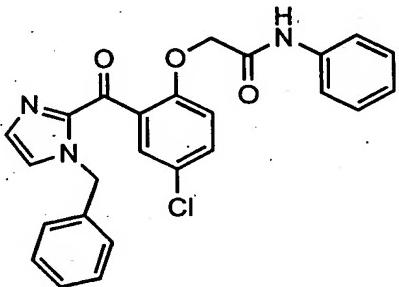
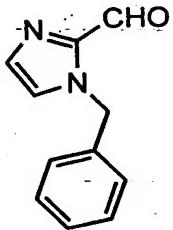


**175**

Carboxylic acid **119** (0.15 g, 0.51 mmol), amine **399** (0.11 g, 0.51 mmol), HOBr (0.07 g, 0.51 mmol), EDAC (0.1 g, 0.51 mmol), Et<sub>3</sub>N (0.14 mL, 0.10 g, 1.0 mmol) and anhydrous DMF (5 mL) were used according to general procedure IV. The product was purified by flash chromatography using 2% MeOH:CH<sub>2</sub>Cl<sub>2</sub> as eluant to provide a yellow oil.

Treatment of the oil with diethyl ether provided **175** (0.046 g, 18%) as a pale yellow solid:  
<sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 8.94 (s, 1H), 8.24 (s, 1H), 7.58 (m, 2H), 7.49 (s, 1H), 7.42 (s, 1H), 7.18 (m, 2H), 6.78 (m, 2H), 4.73 (s, 2H), 3.69 (m, 2H), 3.54 (m, 2H), 2.87 (m, 2H), 2.65 (m, 2H), 2.01 (s, 3H). MS (ES): 503 (M<sup>+</sup>).

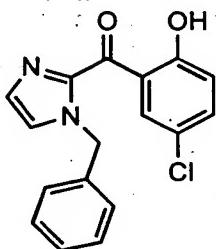
10

**Example 83:****176**15 **Step A:****177**

In a round bottom flask equipped with a stir bar, an addition funnel and nitrogen on demand, 1-Benzylimidazole (2.0 g, 12.6 mmol) was dissolved in anhydrous THF (50 mL) and cooled to -78 °C by means of a dry ice/ acetone bath. N-Butyllithium (8.8 mL of a 1.6 M soln. in hexanes, 13.7 mmol) was added dropwise and the reaction was allowed to stir for 15-20 min at -78 °C. Anhydrous N,N-dimethylformamide (1.3 mL, 0.0013 mmol) was added dropwise and reaction was allowed to stir for an additional 45 min at -78 °C. When judged to be complete, the reaction was quenched by dropwise addition of water and

pad of celite and the filtrate was concentrated under reduced pressure to provide **179** (1.5 g, >99 %) as a clear gel:  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.43 (d,  $J= 4$  Hz, 1H), 7.37 (m, 4H), 7.32 (m, 3H), 7.11 (s, 1H), 6.91 (d,  $J= 12$  Hz, 1H), 5.71 (s, 2H), 3.75 (s, 3H).

5

**Step D:****180**

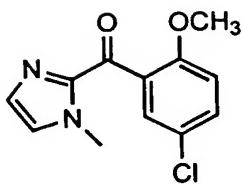
Anisole **179** (1.5 g, 4.6 mmol),  $\text{CH}_2\text{Cl}_2$  (30 mL) and  $\text{BBr}_3$  (12 mL of a 1.0 M soln. in  $\text{CH}_2\text{Cl}_2$ , 11.5 mmol) were used according to general procedure IX. The resulting brown oil was filtered through a pad of silica gel using  $\text{CH}_2\text{Cl}_2$  as eluant and the solvents were removed under reduced pressure to provide **180** (0.9 g, 64%) as a yellow solid:  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.48 (s, 1H), 7.34 (m, 9H), 6.96 (d,  $J= 9$  Hz, 1H), 5.65 (s, 2H).

15

**Step E:**

In a round bottom flask equipped with a stir bar, reflux condensor and nitrogen on demand were added the phenol **180** (0.1 g, 0.32 mmol), acetone (7 mL),  $\text{K}_2\text{CO}_3$  (0.22 g, 1.6 mmol) and the amide # (0.058 g, 0.34 mmol). The reaction was allowed to stir at reflux for 18-24 h, after which it was poured into a separatory funnel containing water and ethyl acetate. The organics were collected, dried over  $\text{Na}_2\text{SO}_4$ , filtered and concentrated under reduced pressure. The resulting product was purified by flash chromatography using 3:1 hexanes/ethyl acetate to 1:3 hexanes/ethyl acetate as a solvent gradient to provide **176** (0.077 g, 54 %) as a white solid:  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  10.17 (s, 1H), 7.70 (m, 3H), 7.39 (m, 11H), 6.94 (d,  $J= 9$  Hz, 1H), 5.79 (s, 2H), 4.71 (s, 2H). MS(ES):  $445(\text{M}^+)$ ,  $446(\text{M}+\text{H})^+$ .

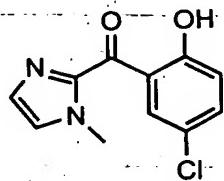
30    **Example 84:**



184.

In a round bottom flask equipped with a stir bar, an addition funnel and nitrogen on demand, 1-methylimidazole (2.0 g, 24.4 mmol) was dissolved in diethyl ether (50 mL) and cooled to -78 °C by means of a dry ice/ acetone bath. N-Butyllithium (15 mL of a 1.6 M soln. in hexanes, 24.4 mmol) was added dropwise and the reaction was allowed to stir for 30 min at -78 °C. Amide 183 (5.1 g, 22.2 mmol) was added as a solid maintaining reaction temp at -78 °C. When judged to be complete, the reaction was quenched by dropwise addition of water and extracted with EtOAc. The organics were collected, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated under reduced pressure. The resulting product was purified by flash chromatography using 1:1 hexanes/ethyl acetate to provide 184 (3.3 g, 55 %): <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 7.60 (s, 1H), 7.53 (dd, J= 3, 9 Hz, 1H), 7.42 (d, J= 3 Hz, 1H), 7.17 (m, 1H), 7.13 (s, 1H), 4.03 (s, 3H), 3.73 (s, 3H).

15

**Step D:**

185

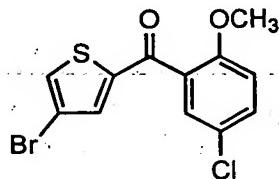
Anisole 184 (3.3 g, 13.2 mmol), CH<sub>2</sub>Cl<sub>2</sub> (60 mL), and BBr<sub>3</sub> (53 mL of a 1.0 M soln. in CH<sub>2</sub>Cl<sub>2</sub>, 53 mmol) were used according to general procedure IX to provide 185 (2.0 g, 69%) as a yellow solid. The product was used in the next step without further purification. <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 7.90 (s, 1H), 7.83 (d, J= 2 Hz, 1H), 7.62 (s, 1H), 7.56 (dd, J= 3, 9 Hz, 1H), 7.04 (d, J= 9 Hz, 1H), 4.03 (s, 3H).

25

**Step E:**

concentrated under reduced pressure to provide **187** (16.3 g, 62%). The product was used in the next step without further purification or characterization.

**Step B:**

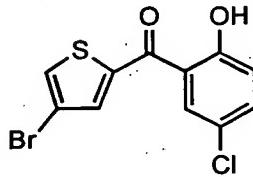


**188**

In a round bottom flask equipped with a stir bar and nitrogen on demand were placed the alcohol **187** (16.3 g, 49 mmol), CH<sub>2</sub>Cl<sub>2</sub> (200 mL), and MnO<sub>2</sub> (21.1 g, 240 mmol). The reaction was allowed to stir at RT for 18-24h, after which time the mixture was filtered through a pad of celite and the solvents were removed under reduced pressure to provide **188** (2.3 g, 14 %) as an orange oil. The product was used in the next step without further purification. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 8.19 (s, 1H), 7.55 (m, 1H), 7.45 (m, 2H), 7.19 (d, J= 9 Hz, 1H), 3.72 (s, 3H).

15

**Step C:**



**189**

Anisole **188** (2.3 g, 7.0 mmol), CH<sub>2</sub>Cl<sub>2</sub> (100 mL), and BBr<sub>3</sub> (21 mL of a 1.0 M soln. in CH<sub>2</sub>Cl<sub>2</sub>, 21 mmol) were used according to general procedure to provide **189** (2.1 g, 94%) as a yellow solid. The product was used without further purification in the next step. <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 10.45 (s, 1H), 8.24 (s, 1H), 7.57 (d, J= 1.2 Hz, 1H), 7.46 (m, 2H), 7.02 (d, J= 9 Hz, 1H).

25

**Step D:**

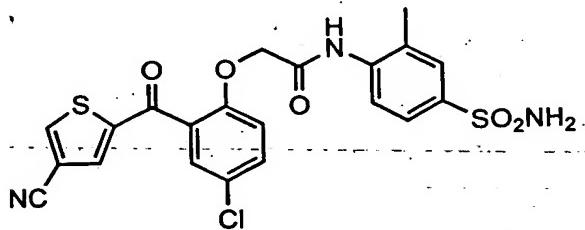
**192**

Ester **191** (0.7 g, 2 mmol), THF (10 mL), water (5 mL), EtOH (5 mL) and LiOH (0.2 g, 5 mmol) were used according to general procedure III to provide **192** (0.5 g, 80 %) as an orange gel. The product was used in the next step without further purification or characterization.

**Step G:**

**10** Carboxylic acid **192** (0.16 g, 0.49 mmol), amine **399** (0.13 g, 0.34 mmol), HOBr (0.079 g, 0.34 mmol), EDAC (0.14 g, 0.34 mmol) and anhydrous DMF (7 mL) were used according to general procedure IV. Treatment of resulting product with diethyl ether provided **186** (0.052 g, 21 %) as a pale yellow solid:  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  9.11 (s, 1H), 8.94 (s, 1H), 8.12 (s, 1H), 7.62 (d, J = 9 Hz, 1H), 7.53 (d, J = 2.4 Hz, 1H), 7.20 (d, J = 9 Hz, 1H), 7.14 (d, J = 9 Hz, 1H), 6.84 (s, 1H), 6.77 (d, J = 8 Hz, 1H), 4.77 (s, 2H), 3.70 (m, 2H), 3.52 (m, 2H), 2.87 (m, 2H), 2.63 (m, 2H), 2.03 (s, 3H). MS(ES): 528 (M<sup>+</sup>).

15

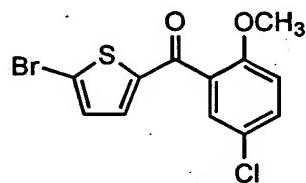
**Example 86:**

20

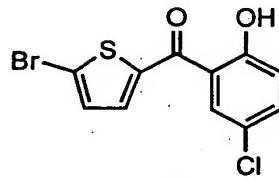
**193**

In a round bottom flask equipped with a stir bar and nitrogen on demand was added the acid **192** (0.36 g, 1.1 mmol), CH<sub>2</sub>Cl<sub>2</sub> (20 mL) and oxalyl chloride (0.1 mL, 0.14 g, 1.1 mmol). The mixture was cooled to 0 °C and N,N-dimethylformamide (1-2 drops) was added. The reaction was allowed to warm to rt over a period of 30-60 min, after which time the mixture was concentrated under reduced pressure to afford the acid chloride. The acid chloride, acetonitrile (20 mL), triethylamine (0.4 mL, 0.29 g, 2.9 mmol) and the sulfonamide (0.26 g, 1.4 mmol) were combined and allowed to stir at RT for 18-24 h. When judged to be complete, the reaction was poured into a separatory funnel containing water and ethyl acetate. The organics were collected, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and the

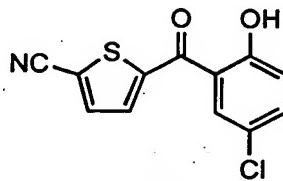
30

**Step B:****196**

- 5 To a round bottom flask equipped with a stir bar and nitrogen on demand was added the alcohol **195** (20 g, 60 mmol),  $\text{CH}_2\text{Cl}_2$  (300 mL), and  $\text{MnO}_2$  (15.6 g, 180 mmol). The reaction was allowed to stir at RT for 90 min, after which time it was filtered through a pad of celite and the filtrate was concentrated under reduced pressure to provide **196** (15.3 g, 77-%) as a pale yellow oil. The product was used in the next step without further purification.
- 10  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  7.55 (m, 1H), 7.42 (s, 1H), 7.33 (t,  $J$ = 3, 9 Hz, 1H), 7.26 (t,  $J$ = 3 Hz, 1H), 7.17 (m, 1H), 3.72 (s, 3H).

**Step C:****197**

- 15 Anisole **196** (8.2 g, 25 mmol),  $\text{CH}_2\text{Cl}_2$  (175 mL), and  $\text{BBr}_3$  (74 mL of a 1.0 M soln. in  $\text{CH}_2\text{Cl}_2$ , 74 mmol) were used according to general procedure IX to provide **197** (6.8 g, 87%). The product was used in the next step without further purification.  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  10.35 (s, 1H), 7.39 (dd,  $J$ = 2.4, 6 Hz, 1H), 7.35 (m, 4H), 6.94 (dd,  $J$ = 3, 9 Hz, 1H).

**Step D:****198**

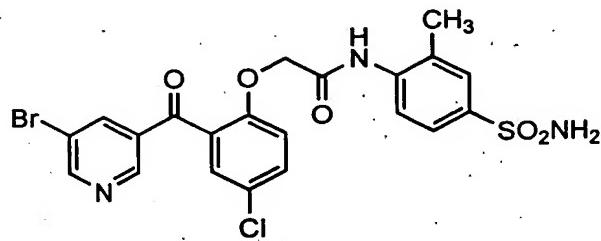
as an orange gel. The product was used in the next step without further purification or characterization.

**Step G:**

5 Carboxylic acid **200** (0.42 g, 1.3 mmol), amine **399** (0.36 g, 1.6 mmol), HOt (0.22 g, 1.6 mmol), EDAC (0.38 g, 2.0 mmol) and anhydrous DMF (7 mL) were used according to general procedure IV. The resulting brown oil was purified by flash chromatography using 2 % MeOH/CH<sub>2</sub>Cl<sub>2</sub> as eluant. Treatment of the resulting product with diethyl ether provided **194** (0.071 g, 10 %) as a white solid: <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 9.08 (s, 1H), 7.83 (d, J= 4.5 Hz, 1H), 7.69 (m, 2H), 7.61 (s, 1H), 7.27 (d, J= 9 Hz, 1H), 7.18 (d, J= 9 Hz, 1H), 6.90 (s, 1H), 6.83 (d, J= 8.4 Hz, 1H), 4.80 (s, 2H), 3.76 (m, 2H), 3.58 (m, 2H), 2.93 (m, 2H), 2.71 (m, 2H), 2.07 (s, 3 H).

15

**Example 88:**

**201**

20

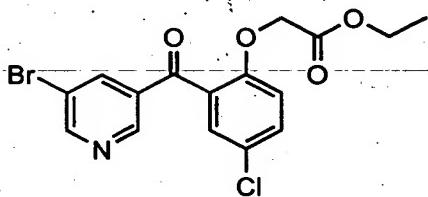
**Step A:**

**202**

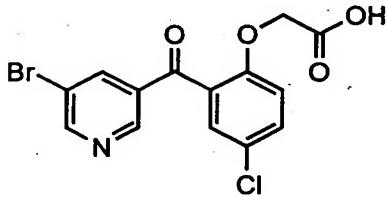
25 5-Bromonicotinic acid (5.0g, 0.025 mol), oxalyl chloride (2.4 mL, 3.5g, 0.027 mol), methylene chloride (125 mL), and N,N-dimethylformamide (2 drops) were used according to general procedure V to provide **202** (6.0g, >100%) as a white solid. The product was

**205**

Anisole **204** (2.0 g, 6.1 mmol),  $\text{BBr}_3$  (18.4 mL of a 1.0 M soln. in  $\text{CH}_2\text{Cl}_2$ , 18.4 mmol), and  $\text{CH}_2\text{Cl}_2$  (50 mL) were used according to general procedure IX to afford **205** (3.4 g, >100%) as a yellow foam. The product was used in the next step without further purification.  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  10.57 (s, 1H), 8.91 (d,  $J=2.4$  Hz, 1H), 8.75 (d,  $J=1.6$  Hz, 1H), 8.21 (t,  $J=2$  Hz, 1H), 7.48 (dd,  $J=2.8, 8.8$  Hz, 1H), 7.41 (d,  $J=2.8$  Hz, 1H), 6.97 (d,  $J=8.8$  Hz, 1H). MS (ES): 314 ( $\text{M}+\text{H})^+$ , 312 ( $\text{M}-\text{H}$ ).

**10 Step E:****206**

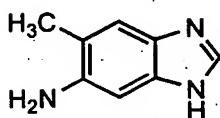
Phenol **205** (0.55 g, 1.7 mmol), ethyl bromoacetate (0.21 mL, 0.32 g, 1.9 mmol),  $\text{K}_2\text{CO}_3$  (0.73 g, 5.3 mmol), and acetone (25 mL) were used according to general procedure II to provide **206** (0.58 g, 83%) as a red oil. The product was used in the next step without further purification.  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  8.97 (d,  $J=2.4$  Hz, 1H), 8.84 (d,  $J=1.8$  Hz, 1H), 8.30 (t,  $J=1.8$  Hz, 1H), 7.66 (dd,  $J=2.7, 9$  Hz, 1H), 7.57 (d,  $J=2.7$  Hz, 1H), 7.19 (d,  $J=9$  Hz, 1H), 4.82 (s, 2H), 4.18 (m, 2H), 1.2 (m, 3H).

**20****Step F:****207**

Ester **206** (0.58 g, 1.45 mmol),  $\text{LiOH}$  (0.15 g, 3.64 mmol) and a solution of THF, EtOH, and water (20 mL) were used according to general procedure III. The resulting orange residue was treated with diethyl ether to afford **207** (0.2 g, 42%) as a yellow solid. The product was used the next step without further purification or characterization.

recrystallized using 1:1 methanol:water, making sure to filter any undissolved material while mixture was hot, to obtain **209** (1.8 g, 34 %) as a pale yellow solid.  $^1\text{H}$  NMR (300 MHz, DMSO-d<sub>6</sub>)  $\delta$  12.96 (bs, 1H), 8.48 (s, 1H), 8.34 (s, 1H), 7.65 (s, 1H), 2.64 (s, 3H). MS (ES): 222 (M-H)<sup>+</sup>.

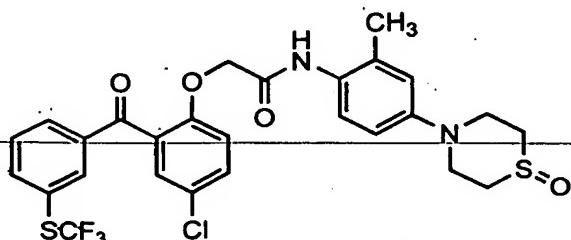
5

**Step B:****210**

10 To a plastic-coated reaction vessel equipped with a stir bar, was added the nitro derivative **209** (2.2 g, 0.012 mol), absolute ethanol (75 mL), and palladium on charcoal (0.23 g of 10% Pd/C, 10% by weight). The vessel was placed on a hydrogenation apparatus at 50 psig for 16 h. When judged to be complete, the reaction was filtered through a celite plug and the solvents were removed under reduced pressure to provide a residue. The residue was washed several times with diethyl ether to afford **210** (1.0g, 57%) as a pink solid. At ambient temperature, the product exists as a mixture of tautomers.  $^1\text{H}$  NMR (300 MHz, DMSO-d<sub>6</sub>, 100 °C)  $\delta$  11.60 (bs, 1H), 7.79 (s, 1H), 7.20 (s, 1H), 6.82 (s, 1H), 4.39 (bs, 2H), 2.20 (s, 3H). MS (ES): 148 (M+H)<sup>+</sup>.

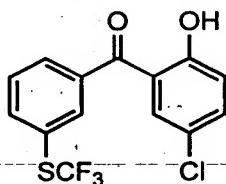
15 **Step C:**

20 Acid **207** (0.1 g, 0.27 mmol), HOBr (40 mg, 0.27mmol), EDAC (52 mg, 0.27 mmol), , aniline **210** (40 mg, 0.27 mmol), and N,N-dimethylformamide (5 mL) were used according to general procedure IV. The product was purified by flash chromatography 25 using 2% MeOH: 1% Et<sub>3</sub>N: CHCl<sub>3</sub> as eluant to afford **208** (7.6 mg, 5%) as a pale yellow solid.  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  9.18 (s, 1H), 8.85 (m, 2H), 8.30 (s, 1H), 8.12 (s, 1H), 7.66 (d, J= 7 Hz, 1H), 7.53 (m, 2H), 7.37 (m, 1H), 7.23 (d, J= 9 Hz, 1H), 4.75 (s, 2H), 2.12 (s, 3H). MS (ES): 501 (M+H)<sup>+</sup>.

30 **Example 90:**

Amide **213** (0.8 g, 3.0 mmol), n-butyllithium (1.3 mL of a 2.5 M soln. in hexanes, 3.3 mmol), 2-bromo-4-chloroanisole (0.41 mL, 0.66 g, 3.0 mmol), and diethyl ether (10 mL) were used according to general procedure VIII. The product was purified by flash chromatography using 7:3 hexanes:ethyl acetate as eluant to afford **214** (0.56 g, 55%). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 7.97 (d, J= 8 Hz, 1H), 7.87 (m, 2H), 7.68 (d, J= 8 Hz, 1H), 7.60 (dd, J= 2.4, 8.8 Hz, 1H), 7.45 (d, J=2.8 Hz, 1H), 7.21 (d, J= 8.8 Hz, 1H), 3.62 (s, 3H).

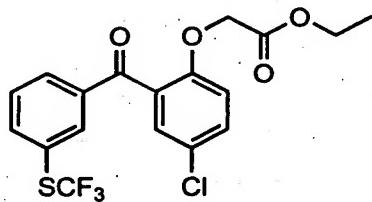
**Step D:**



**215**

Anisole **214** (0.56 g, 1.6 mmol), BBr<sub>3</sub> (2.0 mL of a 1.0 M soln. in CH<sub>2</sub>Cl<sub>2</sub>, 2.0 mmol), and CH<sub>2</sub>Cl<sub>2</sub> (10 mL) were used according to general procedure IX to afford **215** (0.45 g, 86%). The product was used in the next step without further purification. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 10.42 (s, 1H), 7.95 (m, 2H), 7.87 (d, J= 8 Hz, 1H), 7.66 (t, J=8 Hz, 1H), 7.44 (dd, J=2.8, 8.8 Hz, 1H), 7.35 (d, J=2.8 Hz, 1H), 6.96 (d, J=8.8 Hz, 1H). MS (ES): 331 (M-H)<sup>-</sup>

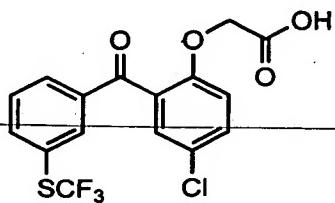
**Step E:**



**216**

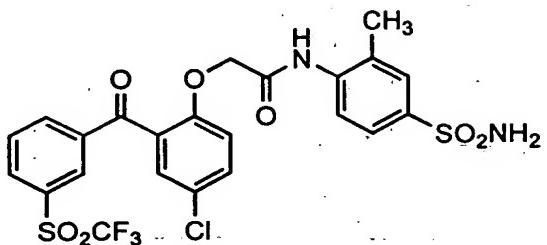
Phenol **215** (0.45 g, 1.4 mmol), ethyl bromoacetate (0.17 mL, 0.25 g, 1.5 mmol), K<sub>2</sub>CO<sub>3</sub> (0.48 g, 2.5 mmol), and acetone (20 mL) were used according to general procedure II to provide **216** (0.6 g, >100%) as a yellow oil. The product was used in the next step without further purification or characterization.

**Step F:**



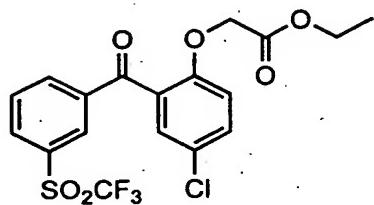
diethyl ether to afford **218** (50 mg, 45%) as a white solid.  $^1\text{H}$  NMR (300 MHz, DMSO-d<sub>6</sub>)  $\delta$  9.44 (s, 1H), 8.38 (m, 3H), 8.01 (m, 1H), 7.70 (m, 5H), 7.31 (m, 3H), 4.80 (s, 2H), 2.16 (s, 3H). MS (ES): 559 (M $^+$ ).

5    **Example 92**



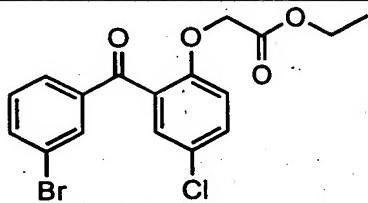
219

10    **Step A:**



220

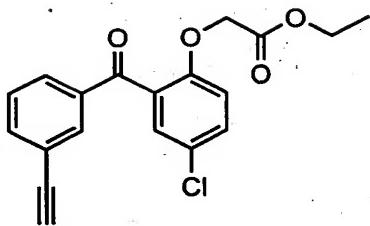
To a round-bottom flask equipped with a stir bar, nitrogen on demand, and an addition funnel, were placed the ester **216** (0.56 g, 1.34 mmol) and CH<sub>2</sub>Cl<sub>2</sub> (25 mL) and the reaction mixture was cooled to 0 °C. A solution of m-chloroperoxybenzoic acid in CH<sub>2</sub>Cl<sub>2</sub> (10 mL) was added dropwise via addition funnel and the resulting mixture was allowed to stir at 0 °C for 0.5 h, after which time it was allowed to warm to rt and stir for an additional 16 h. When judged to be complete, the reaction was quenched with 10% sodium metabisulfite solution and extracted with CH<sub>2</sub>Cl<sub>2</sub>. The organics were collected, washed with saturated NaHCO<sub>3</sub>, dried over MgSO<sub>4</sub>, filtered and the solvent was removed under reduced pressure to afford **220** (0.56 g, 93%) as a pale yellow oil. The product was used in the next reaction without further purification.  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  8.38 (d, J= 8 Hz, 1H), 8.29 (d, J= 8 Hz, 1H), 8.22 (s, 1H), 7.96 (t, J= 7.6 Hz, 1H), 7.62 (dd, J= 2.8, 9.2 Hz, 1H), 7.55 (d, J=2.8 Hz, 1H), 7.17 (d, J=8.8 Hz, 1H), 4.70 (s, 2H), 4.05 (m, 2H), 1.21 (m, 3H).



223

Phenol 432 (10 g, 0.032 mol), ethyl bromoacetate (3.5 mL, 5.3 g, 0.032 mol),  $K_2CO_3$  (11 g, 0.080 mol), and acetone (120 mL) were used according to general procedure II to afford 223 (11.5 g, 91%) as a yellow oil. The product was used in the next step without further purification.  $^1H$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  7.82 (m, 2H), 7.68 (d,  $J$  = 7.6 Hz, 1H), 7.53 (dd,  $J$  = 2.4, 8.8 Hz, 1H), 7.44 (m, 2H), 7.09 (d,  $J$  = 9.2 Hz, 1H), 4.74 (s, 2H), 4.04 (q,  $J$  = 7.2 Hz, 2H), 1.13 (m, 3H).

10

**Step B:**

224

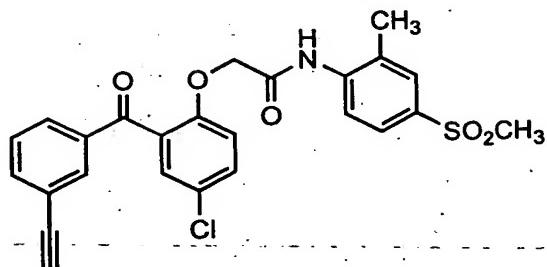
To a round-bottom flask equipped with a stir bar and nitrogen on demand were added the ester 223 (1.5 g, 3.8 mmol), trimethylsilylacetylene (0.6 mL, 0.4 g, 4.1 mmol), tetrakis(triphenylphosphine)palladium (0) (0.31 g, 0.27 mmol), copper(I) iodide (0.15 g, 0.80 mmol), triethylamine (1.7 mL, 1.2 g, 0.80 mmol), and N,N-dimethylformamide (15 mL) and the reaction was allowed to stir at 80 °C for 18h. When judged to be complete, the reaction mixture was poured into ethyl acetate and water. The organics were collected, washed with water and brine, dried over  $Na_2SO_4$ , filtered through a pad of celite, and the solvents were removed under reduced pressure. To the resulting residue was added tetrahydrofuran (20 mL) and tetrabutylammonium fluoride (3 mL). The mixture was allowed to stir at RT for 10 min, after which it was poured into a separatory funnel containing ethyl acetate and water. The organics were collected, dried over  $Na_2SO_4$ , filtered, and the solvents were removed under reduced pressure. The resulting product

226

**Step A:**

5 Acid 225 (80 mg, 0.25 mmol), oxalyl chloride (0.024mL, 35mg, 0.28 mmol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (3 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline 466 (48 mg, 0.26 mmol), NaHCO<sub>3</sub> (105 mg, 1.3 mmol), acetone (7 mL), and water (0.5 mL) were used 10 according to general procedure VI. The product was purified by flash chromatography using 5% MeOH:CHCl<sub>3</sub> to afford 226 (20 mg, 16%) as a white solid. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 9.30 (s, 1H), 7.77 (d, J= 7.6 Hz, 1H), 7.70 (d, J= 7.6 Hz, 1H), 7.58 (m, 4H), 7.45 (m, 2H), 7.22 (m, 3H), 4.77 (s, 2H), 4.27 (s, 1H), 2.13 (s, 3H). MS ES): 482 (M<sup>+</sup>), 481 (M-H).

15

**Example 95**

227

20

**Step A:**

228

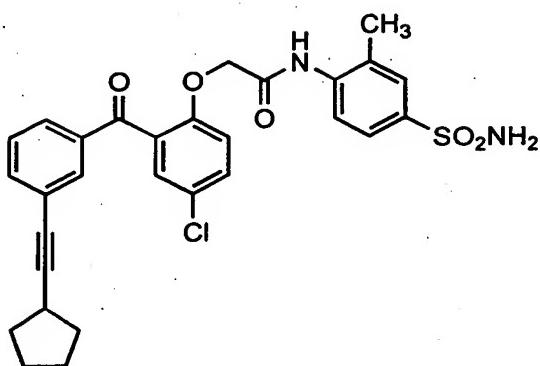
25 To a round-bottom flask equipped with a stir bar and nitrogen on demand was added 5-fluoro-2-nitrotoluene (2.4 mL, 3.0 g, 0.019 mol), sodium thiomethoxide (1.5 g, 0.021

**230**

To a plastic-coated reaction vessel equipped with a stir bar, was added the nitro derivative **229** (1.5 g, 6.9 mmol), toluene (50 mL), and palladium on charcoal (0.15 g of 10% Pd/C, 10% by weight). The vessel was placed on a hydrogenation apparatus at 50 p.s.i. for 7 h. When judged to be complete, the reaction was filtered through a celite plug and the solvents were removed under reduced pressure to provide a crystalline material. The residue was washed several times with diethyl ether to afford **230** (1.3 g, >99%). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 7.36 (m, 2H), 6.65 (d, J= 8.4 Hz, 1H), 5.81 (s, 2H), 2.98 (s, 3H), 2.06 (s, 3H).

**Step D:**

Acid **225** (107 mg, 0.34 mmol), oxalyl chloride (0.032mL, 47mg, 0.37 mmol), N, N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (7 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline **230** (63 mg, 0.34 mmol), NaHCO<sub>3</sub> (143 mg, 1.7 mmol), acetone (7 mL), and water (0.5 mL) were used according to general procedure VI. The product was purified by flash chromatography using 5% MeOH:CHCl<sub>3</sub> to afford **227** (8 mg, 5%) as a white solid. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 9.34 (s, 1H), 7.73 (m, 6H), 7.60 (dd, J= 2.8, 8.8 Hz, 1H), 7.50 (t, J= 8 Hz, 1H), 7.46 (d, J= 2.4 Hz, 1H), 7.21 (d, J= 8.8 Hz, 1H), 4.79 (s, 2H), 4.29 (s, 1H), 3.27 (s, 3H), 2.18 (s, 3H). MS ES): 481 (M-H)<sup>-</sup>.

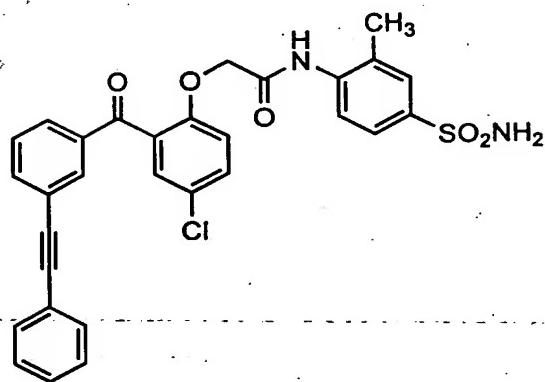
**Example 96**

>99%). The product was used in the next step without further purification or characterization.

**Step C:**

5 Acid 233 (140 mg, 0.37 mmol), oxalyl chloride (0.033mL, 48mg, 0.38 mmol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (5 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline 466 (73 mg, 0.39 mmol), NaHCO<sub>3</sub> (155 mg, 1.85 mmol), acetone (7 mL), and water (0.5 mL) were used  
10 according to general procedure VI. The product was purified by flash chromatography using 5% MeOH:CHCl<sub>3</sub> to afford 231 (88 mg, 43%) as a white solid. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 9.28 (s, 1H), 7.61 (m, 8H), 7.44 (m, 2H), 7.21 (m, 2H), 4.77 (s, 2H), 2.81 (m, 1H), 2.14 (s, 3H), 1.93 (m, 2H), 1.58 (m, 6H).

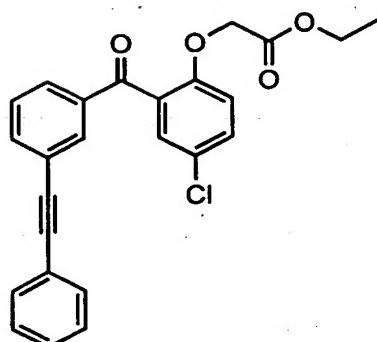
15 **Example 97**



234

**Step A:**

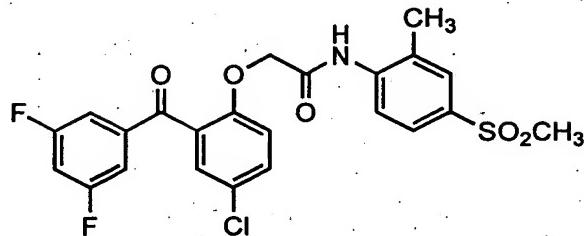
20



235

afford **234** (10 mg, 11%) as a white solid.  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  9.34 (s, 1H), 7.90 (s, 1H), 7.79 (m, 2H), 7.62 (m, 3H), 7.54 (m, 4H), 7.47 (d, J = 3 Hz, 1H), 7.38 (m, 3H), 7.22 (m, 3H), 4.80 (s, 2H), 2.15 (s, 3H).

5    **Example 98**

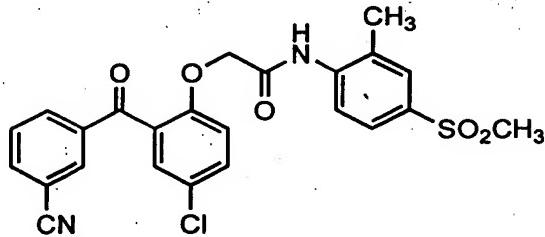


237

Step A:

10   Acid **49** (120 mg, 0.37 mmol), oxalyl chloride (0.035 mL, 50 mg, 0.40 mmol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (7 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline **230** (69 mg, 0.37 mmol), NaHCO<sub>3</sub> (155 mg, 1.85 mmol), acetone (7 mL), and water (0.5 mL) were used according to general procedure VI. The resulting yellow oil was treated with pentanes to afford **237** (39 mg, 21%) as a pale yellow solid.  $^1\text{H}$  NMR (300 MHz, DMSO-d<sub>6</sub>)  $\delta$  9.51 (s, 1H), 7.66 (m, 5H), 7.53 (d, J = 2.7 Hz, 1H), 7.49 (m, 2H), 7.25 (d, J = 9 Hz, 1H), 4.87 (s, 2H), 3.20 (s, 3H), 2.26 (s, 3H). MS (ES): 494 (M<sup>+</sup>).

15   **Example 99**

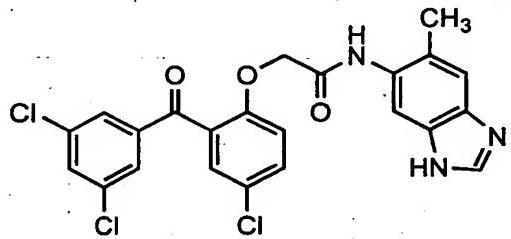


238

20   Acid **129** (120 mg, 0.38 mmol), oxalyl chloride (0.037 mL, 53 mg, 0.42 mmol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (7 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline **230** (70 mg, 0.38

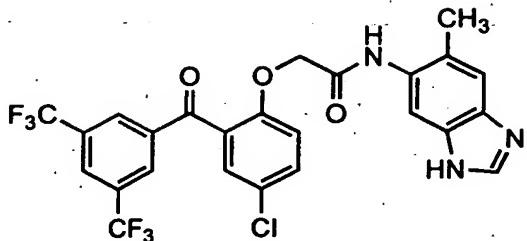
mmol), NaHCO<sub>3</sub> (155 mg, 1.9 mmol), acetone (10 mL), and water (0.5 mL) were used according to general procedure VI. The product purified by flash chromatography using 5% MeOH:CHCl<sub>3</sub> to afford 240 (22 mg, 13%) as a pale yellow solid. At ambient temperature the product exists as a mixture of tautomers. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 12.26 (m, 1H), 9.14 (m, 1H), 8.09 (s, 1H), 7.64 (d, J = 9 Hz, 1H), 7.50 (m, 4H), 7.23 (m, 2H), 4.75 (m, 2H), 2.12 (m, 3H). MS (ES): 456 (M<sup>+</sup>), 457 (M+H)<sup>+</sup>, 455(M-H)<sup>-</sup>.

### Example 102



10 Acid 76 (120 mg, 0.33 mmol), oxalyl chloride (0.032 mL, 46 mg, 0.37 mmol), N, N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (10 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline 210 (51 mg, 0.35 mmol), NaHCO<sub>3</sub> (139 mg, 1.7 mmol), acetone (10 mL), and water (0.5 mL) were used according to general procedure VI. The product purified by flash chromatography using 2% MeOH:CH<sub>2</sub>Cl<sub>2</sub> to afford 241 (11 mg, 7%) as a white solid. At ambient temperature the product exists as a mixture of tautomers. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 12.26 (s, 1H), 9.15 (m, 1H), 8.09 (s, 1H), 7.87 (m, 1H), 7.70 (m, 2H), 7.64 (m, 1H), 7.55 (m, 2H), 7.21 (m, 1H), 4.75 (m, 2H), 2.12 (m, 3H). MS (ES): 490 (M+H)<sup>+</sup>, 488 (M-H)<sup>-</sup>.

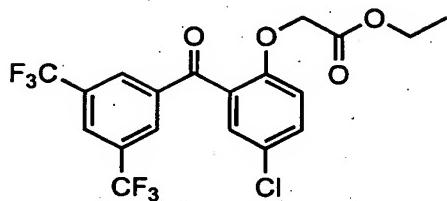
### Example 103



Anisole **244** (3.76 g, 9.8 mmol),  $\text{BBr}_3$  (29 mL of a 1.0 M soln. in  $\text{CH}_2\text{Cl}_2$ , 29 mmol), and  $\text{CH}_2\text{Cl}_2$  (80 mL) were used according to general procedure IX to afford **245** (3.2 g, 89%) a pale green solid. The product was used in the next step without further purification.  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-d}_6$ )  $\delta$  10.6 (s, 1H), 8.40 (s, 1H), 8.21 (s, 2H), 7.48 (m, 2H), 6.98 (d,  $J$ = 8.8 Hz, 1H).

5

#### Step D:

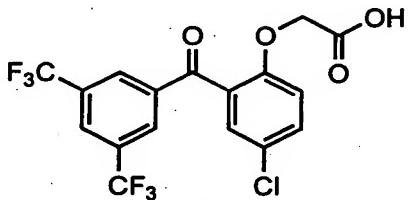


246

10 Phenol **245** (3.2 g, 8.7 mmol), ethyl bromoacetate (1.1 mL, 1.6 g, 9.5 mmol),  $\text{K}_2\text{CO}_3$  (3.0 g, 21.7 mmol), and acetone (50 mL) were used according to general procedure II to provide **246** (3.8 g, 97%) as a pale yellow solid. The product was used in the next step without further purification.  $^1\text{H}$  NMR (300 MHz,  $\text{DMSO-d}_6$ )  $\delta$  8.47 (s, 1H), 8.31 (s, 2H), 7.68 (dd,  $J$ = 3, 9 Hz, 1H), 7.61 (d,  $J$ = 2.4 Hz, 1H), 7.21 (d,  $J$ = 9 Hz, 1H), 4.79 (s, 2H), 4.06 (q,  $J$ = 7 Hz, 2H), 1.13 (t,  $J$ = 7 Hz, 3H).

15

#### Step E:



247

20 Ester **246** (3.8 g, 8.4 mmol),  $\text{LiOH}$  (0.88 g, 20.9 mmol) and a solution of THF, EtOH, and water (25 mL) were used according to general procedure III. The resulting white foam was treated with diethyl ether to afford **247** (3.1 g, 86%) as a white solid.  $^1\text{H}$  NMR (300 MHz,  $\text{DMSO-d}_6$ )  $\delta$  8.44 (s, 1H), 8.34 (s, 2H), 7.67 (dd,  $J$ = 3, 9 Hz, 1H), 7.58 (d,  $J$ = 3 Hz, 1H), 7.16 (d,  $J$ = 9 Hz, 1H), 4.63 (s, 2H).

25

(2.46 g, 69%).  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  7.49 (d, J= 2.4 Hz, 1H), 7.37 (d, J= 8.4 Hz, 1H), 7.21 (dd, J= 2.4, 8.4 Hz, 1H), 4.11 (t, J= 6 Hz, 2H), 3.63 (t, J= 6 Hz, 2H), 2.38 (s, 3H), 2.22 (m, 2H).

**Step B:**

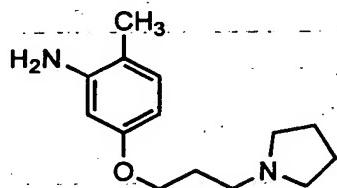
5

**250**

Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed 249 (1.5 g, 5.47 mmol), pyrrolidine (0.91 mL, 0.78 g, 10.9 mmol), potassium carbonate (1.1 g, 8.2 mmol), and N, N-dimethylformamide (30 mL) and the mixture was allowed to stir at rt for 4 h. When judged to be complete, the reaction mixture was poured into a separatory funnel containing ethyl acetate and water. The organics were collected, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and the solvent was removed under reduced pressure to afford 250 (1.24 g, 89%) as a brown oil. The product was used in the next step without further purification or characterization.

15

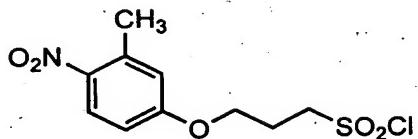
**Step C:**

**251**

20 To a plastic-coated reaction vessel equipped with a stir bar, was added compound 250 (1.3 g, 4.9 mmol), absolute ethanol (20 mL), and palladium on charcoal (0.13 g of 10% Pd/C, 10% w/w). The vessel was placed on a hydrogenation apparatus at 60 p.s.i. for 3 h. When judged to be complete, the reaction was filtered through a celite plug and the solvents were 25 removed under reduced pressure to provide a dark oil. The residue was treated with a small amount of ethyl acetate and hexanes and the resulting precipitate was treated was filtered and the mother liquor was concentrated under reduced pressure to afford 251 (1.0

<sup>°</sup>C and 2-methyl-3-nitrophenol (30 g, 0.20 mol) was added dropwise as a solution in THF (100 mL). The reaction was then allowed to warm to rt, heated to 40 <sup>°</sup>C for 15 min., and then allowed to cool to rt. At this time, 1,3-propane sultone (25.6 g, 0.21 mol) in THF (100 mL) was added dropwise and the reaction was heated to reflux for 4-6 h. When 5 judged to be complete, the reaction mixture was filtered and the resulting solid was washed with absolute ethanol and diethyl ether and dried in a vacuum oven. A solid precipitated out of the mother liquor, was filtered and washed with absolute ethanol and diethyl ether and dried in a vacuum oven to afford 253 (27 g, 46%) of a pale yellow solid.  
<sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 8.06 (d, J= 9 Hz, 1H), 7.05 (d, J= 2.7 Hz, 1H), 6.98 (dd, 10 J= 2.7, 9.3 Hz, 1H), 4.22 (t, J= 6.6 Hz, 2H), 2.58 (m, 2H), 2.52 (s, 3H), 2.04 (m, 2H).

#### Step B:

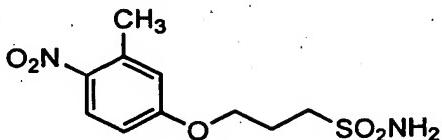


254

15 To a round-bottom flask equipped with a stir bar, an addition funnel, and nitrogen on demand was added the sulfonic acid salt 253 (11 g, 0.037 mol) and N,N-dimethylformamide (250 mL) and the reaction was cooled to 0 <sup>°</sup>C. Thionyl chloride (8.0 mL, 13.0 g, 0.11 mol) was added dropwise and the resulting mixture was allowed to stir at 0 <sup>°</sup>C for 0.5 h, after which time it was allowed to warm to rt and stir for an additional 3 h.  
20 When judged to be complete, the reaction mixture was poured into a beaker of ice and the resulting white precipitate was filtered and placed in a vacuum oven to afford 254 (8.7 g, 80%) as a white solid. <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 8.06 (d, J= 9 Hz, 1H), 7.05 (d, J= 2.7 Hz, 1H), 6.98 (dd, J= 2.7, 9.3 Hz, 1H), 4.22 (t, J= 6.3 Hz, 2H), 2.61 (m, 2H), 2.57 (s, 3H), 2.04 (m, 2H).

25

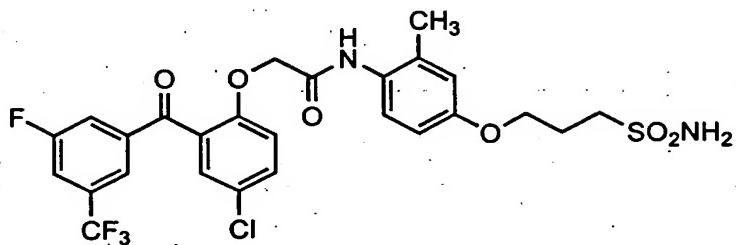
#### Step C:



$J = 2.8$  Hz, 1H), 7.41 (m, 2H), 7.19 (d,  $J = 9.2$  Hz, 1H), 7.11 (d,  $J = 8.4$  Hz, 1H), 6.83 (s, 2H), 6.76 (d,  $J = 2.8$  Hz, 1H), 6.69 (dd,  $J = 2.8, 8.4$  Hz), 4.70 (s, 2H), 4.01 (t,  $J = 6.4$  Hz, 2H), 3.08 (t,  $J = 8$  Hz, 2H), 2.07 (m, 2H), 2.00 (s, 3H). MS (ES): 553 ( $M^+$ ).

5

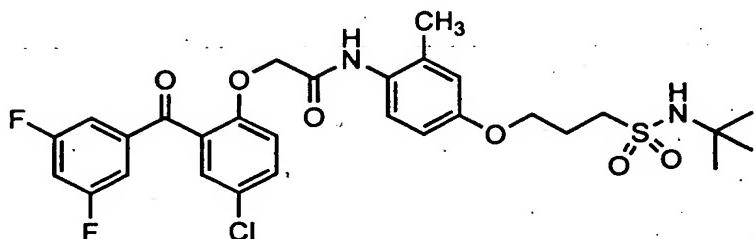
### **Example 106**



257

- 10 Acid 71 (13 g, 0.035 mol), oxalyl chloride (7.0 mL, 9.8 g, 0.077 mol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (100 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline 256 (7.81 g, 0.032 mol), NaHCO<sub>3</sub> (15 g, 0.18 mol), acetone (125 mL), and water (10 mL) were used according to general procedure VI. The product was crystallized from methanol to afford  
 15 257 (10.5 g, 50%) as a white solid. <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 9.16 (s, 1H), 8.05 (d, J = 8.4 Hz, 1H), 7.90 (m, 2H), 7.71 (dd, J = 2.7, 9 Hz, 1H), 7.57 (d, J = 2.7 Hz, 1H), 7.25 (d, J = 9 Hz, 1H), 7.13 (d, J = 9 Hz, 1H), 6.88 (s, 2H), 6.80 (d, J = 2.7 Hz, 1H), 6.73 (dd, J = 2.7, 9 Hz, 1H), 4.74 (s, 2H), 4.07 (t, J = 6 Hz, 2H), 3.13 (m, 2H), 2.13 (m, 2H), 2.03 (s, 3H).  
 20 MS (ES): 602 (M-H)<sup>+</sup>, 603 (M<sup>+</sup>). Anal. Calcd for C<sub>26</sub>H<sub>23</sub>N<sub>2</sub>O<sub>6</sub>ClF<sub>4</sub>S: C, 51.79; H, 3.84; N, 4.65. Found: C, 51.91; H, 3.88; N, 4.66.

**Example 107**

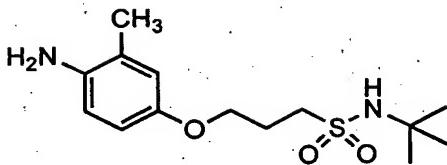


25

258

261

To a round-bottom flask equipped with a stir bar and nitrogen on demand was added t-butylamine (0.33 mL, 0.23 g, 3.1 mmol), triethylamine (0.72 mL, 0.52 g, 5.2 mmol), and 5 chloroform (20 mL). Sulfonyl chloride **260** (0.76 g, 2.6 mmol) in chloroform (3 mL) was added dropwise and the reaction was allowed to stir at rt for 2 h. When judged to be complete, the reaction mixture was poured into a separatory funnel containing CHCl<sub>3</sub> and water, the organics were collected, washed with brine, dried over MgSO<sub>4</sub>, filtered, and the solvents were removed under reduced pressure. The resulting brown residue was filtered 10 through a pad of silica gel, eluting with hexanes to provide **261** (0.37 g, 43%) as a white solid. The product was used in the next step without further purification or characterization.

**Step D:**

15

262

To a plastic-coated reaction vessel equipped with a stir bar, was compound **261** (0.37 g, 1.1 mmol), ethanol (20 mL), and palladium on charcoal (37 mg of 10% Pd/C, 10w/w). The vessel was placed on a hydrogenation apparatus at 60 psig for 2-4 h. When judged to 20 be complete, the reaction was filtered through a celite plug and the solvents were removed under reduced pressure to provide **262** (0.32 g, 95%) as brown oil. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 6.92 (s, 1H), 6.85 (s, 1H), 6.53 (m, 1H), 6.49 (m, 1H), 4.51 (bs, 2H), 3.90 (t, J= 6 Hz, 2H), 3.09 (m, 2H), 2.08 (m, 2H), 1.99 (s, 3H), 1.22 (m, 9H).

**25 Step E:**

Acid **49** (120 mg, 0.37 mmol), oxalyl chloride (0.035 mL, 50 mg, 0.40 mmol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (10 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline **262** (111 mg, 0.37 mmol), NaHCO<sub>3</sub> (155 mg, 1.85 mmol), acetone (10 mL), and water (0.5 mL) were used 30 according to general procedure VI. The product purified by flash chromatography using

265

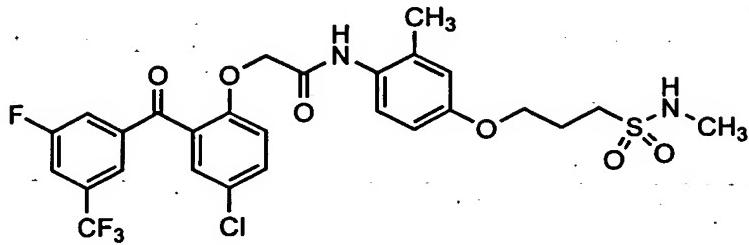
To a plastic-coated reaction vessel equipped with a stir bar, was added the nitro derivative **264** (2.1 g, 7.0 mmol), absolute ethanol (40 mL), and palladium on charcoal (0.21 g of 5 10% Pd/C, 10% by weight). The vessel was placed on a hydrogenation apparatus at 50 p.s.i. for 2-4 h. When judged to be complete, the reaction was filtered through a celite plug and the solvents were removed under reduced pressure to provide **265** (1.7 g, 90%) as a pale yellow solid. The product was used in the next step without further purification or characterization.

10

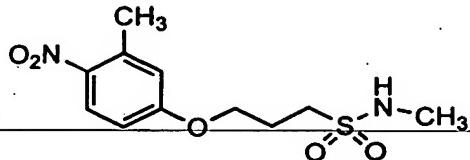
**Step C:**

Acid **71** (120 mg, 0.32 mmol), oxalyl chloride (0.032 mL, 44 mg, 0.35 mmol), N,N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (10 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline **265** (78 mg, 0.29 mmol), NaHCO<sub>3</sub> (134 mg, 1.6 mmol), acetone (6 mL), and water (0.5 mL) were used according to general procedure VI. The resulting residue was treated several times with pentane to afford **263** (90 mg, 45%) as a beige solid. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 9.09 (s, 1H), 7.98 (d, J= 8.4 Hz, 1H), 7.84 (m, 2H), 7.65 (dd, J= 2.4, 8.8 Hz, 1H), 7.51 (d, J= 2.8 Hz, 1H), 7.20 (d, J= 8.8 Hz, 1H), 7.08 (d, J= 8.8 Hz, 1H), 6.76 (d, J= 2.4 Hz, 20 1H), 6.68 (dd, J= 2.8, 8.8 Hz, 1H), 4.69 (s, 2H), 4.00 (t, J= 6 Hz, 2H), 3.13 (m, 2H), 2.75 (s, 6H), 2.05 (m, 2H), 1.98 (s, 3H). MS (ES): 631 (M<sup>+</sup>)

25

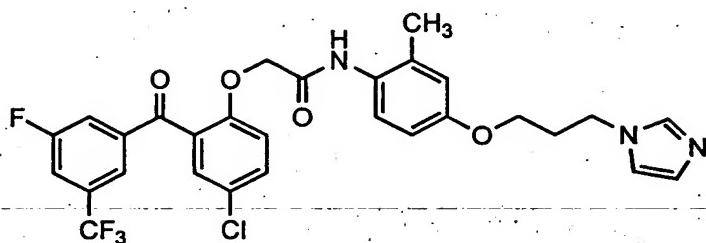
**Example 109**

266

**Step A:**

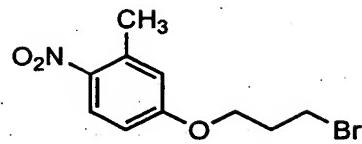
hexanes to afford 266 (80 mg, 41%) as a beige solid.  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  9.09 (s, 1H), 7.98 (d, J= 8.4 Hz, 1H), 7.84 (m, 2H), 7.65 (dd, J= 2.4, 8.8 Hz, 1H), 7.52 (d, J= 2.8 Hz, 1H), 7.20 (d, J= 9.2 Hz, 1H), 7.08 (d, J= 8.4 Hz, 1H), 6.94 (q, J= 5 Hz, 1H), 6.74 (d, J= 2.8 Hz, 1H), 6.68 (dd, J= 2.8, 8.8 Hz, 1H), 4.68 (s, 3H), 4.00 (m, 2H), 3.10 (t, J= 8 Hz, 2H), 2.54 (d, J= 5 Hz), 2.01 (m, 5H). MS (ES): 617 (M<sup>+</sup>).

### Example 110



269

10 Step A:



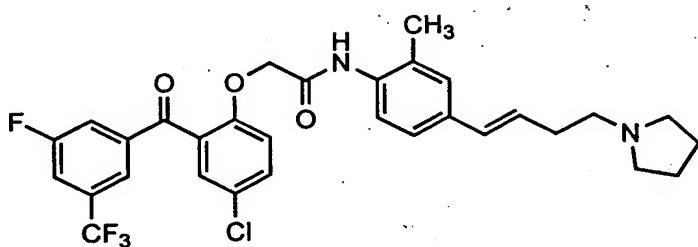
270

Into a round-bottom flask equipped with a stir bar and nitrogen on demand were placed 2-methyl-3-nitrophenol (5.0 g, 0.033 mol), dibromopropane (26 mL, 52.7 g, 0.26 mol), potassium carbonate (6.8 g, 0.05 mol), and N, N-dimethylformamide (100 mL) and the mixture was allowed to stir at rt for 2.5 h. When judged to be complete, the reaction mixture was poured into a separatory funnel containing ethyl acetate and water. The organics were collected, washed with water and brine, dried over MgSO<sub>4</sub>, filtered and the solvent was removed under reduced pressure. The resulting oil was distilled to afford 270 (8.0 g, 89%) a brown oil.  $^1\text{H}$  NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  8.01 (d, J= 9.2 Hz, 1H), 7.02 (d, J= 2.8 Hz, 1H), 6.96 (dd, J= 2.4, 8.8 Hz, 1H), 4.16 (t, J= 6 Hz, 2H), 3.63 (t, J= 6 Hz, 2H), 2.51 (s, 3H), 2.24 (m, 2H).

25 Step B:

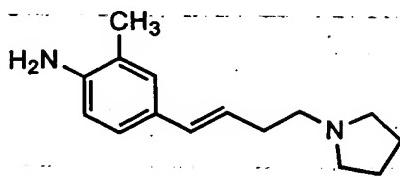
Acid 71 (120 mg, 0.32 mmol), oxalyl chloride (0.032 mL, 44 mg, 0.35 mmol), N, N-dimethylformamide (1 drop), and CH<sub>2</sub>Cl<sub>2</sub> (10 mL) were used according to general procedure V to afford the acid chloride. The acid chloride, aniline 272 (67 mg, 0.29 mmol), NaHCO<sub>3</sub> (134 mg, 1.6 mmol), acetone (6 mL), and water (0.5 mL) were used according to general procedure VI. The product was purified by flash chromatography using 5% MeOH:CHCl<sub>3</sub> as eluant to afford 269 (84 mg, 45%) as a pink solid. <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 9.15 (s, 1H), 8.05 (d, J= 9 Hz, 1H), 7.90 (m, 2H), 7.71 (dd, J= 3, 9 Hz, 1H), 7.65 (s, 1H), 7.57 (d, J= 3 Hz, 1H), 7.24 (m, 2H), 7.13 (d, J= 6Hz, 1H), 6.92 (s, 1H), 6.79 (d, J=3 Hz, 1H), 6.73 (dd, J= 3, 9 Hz, 1H), 4.74 (s, 2H), 4.14 (t, J= 6Hz, 2H), 3.88 (t, J= 6Hz, 2H), 2.16 (m, 2H), 2.03 (s, 3H). MS (ES): 589 (M<sup>+</sup>), 590 (M+H)<sup>+</sup>.

### Example 111



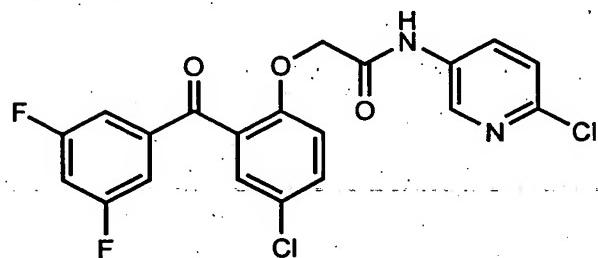
272

#### 15 Step A:

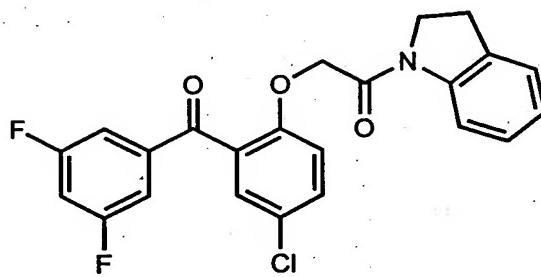


273

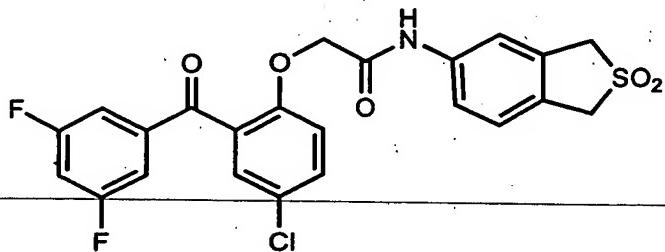
To a sealed-tube reaction vessel equipped with a stir bar and nitrogen on demand was added 4-bromo-2-methyl aniline (0.8 g, 4.3 mmol), palladium (II) acetate (97 mg, 0.43 mmol), tri-o-tolylphosphine (0.52 g, 1.72 mmol), N,N-dimethylformamide (15 mL), N-butylenepyrrolidine (2.7 g, 21.5 mmol), and triethylamine (4.2 mL, 3.0 g, 30.1 mmol). The tube was sealed and allowed to stir at 80 °C for 18 h. When judged to be complete, the reaction was filtered through a pad of celite and the filtrate was poured into ethyl acetate and water. The organics were collected and washed with water and brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure. The product

**Example 113****275**

The title compound was prepared according to General Procedure VI from acid **49** (0.51 mmol) and 5-amino-2-methoxypyridine (0.05 mL, 0.44 mmol). Purification by flash chromatography using 25% ethyl acetate/hexane as eluant followed by trituration with ether gave **275** (0.134 g, 70%): mp 198-200 °C; MS (ES+) *m/z* 437 (M+H); <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 9.79 (s, 1 H), 8.80 (d, 1 H), 8.30 (dd, 1 H), 7.58 (dd, 1 H), 7.41 (dd, 1 H), 7.39-7.38 (m, 2 H), 7.32 (d, 1 H), 7.15-7.11 (m, 1 H), 7.07 (d, 1 H), 4.76 (s, 2 H).

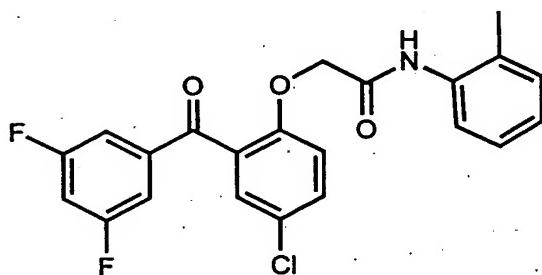
**Example 114****276**

The title compound was prepared according to General Procedure VI from acid **49** (0.51 mmol) and indoline (0.05 mL, 0.44 mmol). Purification by flash chromatography using 25% ethyl acetate/hexane as eluant followed by crystallization from methylene chloride/hexane gave **276** (0.069 g, 37%): mp 158-160 °C; MS (ES+) *m/z* 428 (M+H); <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.14 (d, 1 H), 7.44-7.39 (m, 4 H), 7.22-7.18 (m, 2 H), 7.07-6.97 (m, 3 H), 4.70 (s, 2 H), 3.98 (t, 2 H), 3.18 (t, 2 H) ppm.

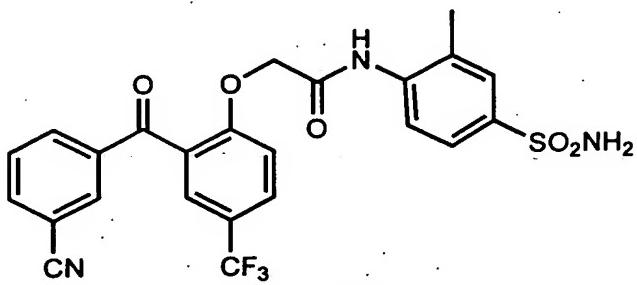
**Example 115**

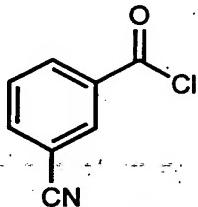
**279**

The title compound was prepared according to General Procedure VI from acid **49** (0.49 mmol) and 1,2,3,4-tetrahydroisoquinoline (0.035 mL, 0.41 mmol). Isolation by flash chromatography using 15% ethyl acetate/hexane as eluant followed by trituration with hexanes gave **279** (0.072 g, 40%) in ca. 80% purity: MS (ES+) *m/z* 442 (M+H), 464 (M+Na); <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.43-7.39 (m, 1 H), 7.34-7.27 (m, 3 H), 7.19-7.15 (m, 2 H), 7.13-7.08 (m, 2 H), 7.02-6.93 (m, 2 H), 4.70 (s, 2 H), 4.65 (s, 1 H), 4.46 (s, 1 H), 3.73 (t, 1 H), 3.57 (t, 1 H), 2.81-2.75 (m, 2 H).

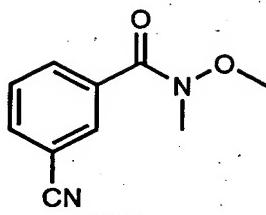
**10 Example 118****280**

The title compound was prepared according to General Procedure VI from acid **49** (0.50 mmol) and *o*-toluidine (0.05 mL, 0.43 mmol). Isolation by flash chromatography using 15% ethyl acetate/hexane as eluant gave **280** (0.121 g, 58%): MS (ES+) *m/z* 416 (M+H), 438 (M+Na); MS (ES-) *m/z* 414 (M-H); <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.30 (br s, 1 H), 7.71 (d, 1 H), 7.53 (dd, 1 H), 7.36 (d, 1 H), 7.34-7.31 (m, 2 H), 7.22-7.17 (m, 2 H), 7.09 (app t, 1 H), 7.05 -7.01 (m, 2 H), 4.77 (s, 2 H), 2.18 (s, 3 H) ppm.

**20 Example 119****281**

**Step C:**

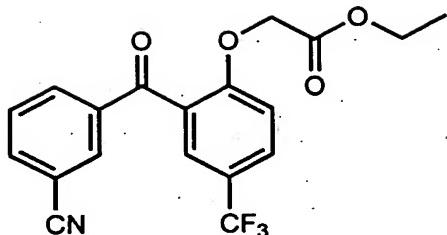
Oxalyl chloride (48 mL, 96.5 mmol) was added dropwise over 1 h to a solution of 3-cyanobenzoic acid (5.767 g, 38.6 mmol) in 200 mL of  $\text{CH}_2\text{Cl}_2$  and 0.10 mL of DMF, and the resulting mixture was stirred at room temperature for 20 h. The reaction mixture was concentrated *in vacuo* to give 284 (8.516 g), which was used immediately without further purification or characterization.

**10 Step D:**

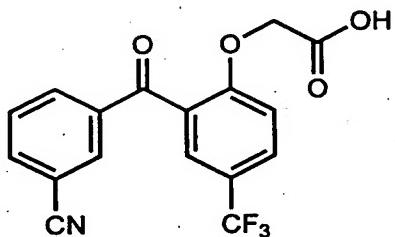
A solution of N,O-dimethylhydroxylamine (4.90 g, 50.2 mmol) in 20 mL of triethylamine and 100 mL of chloroform was cooled to 0 °C, and 284 (8.52 g, 38.6 mmol) was added dropwise over 10 min. The resulting mixture was stirred at 0 °C for 10 min, then allowed to warm to room temperature over 1.25 h. The reaction mixture was diluted with 150 mL ethyl acetate and washed with two 100-mL portions of water and a small portion of brine. The organic layer was then dried over  $\text{MgSO}_4$ , filtered, and concentrated *in vacuo* to give 285 (6.381 g, 90%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.02 (s, 1 H), 7.95 (d, 1 H), 7.75 (d, 1 H), 7.55 (dd, 1 H), 3.54 (s, 3 H), 3.39 (s, 3 H).

20

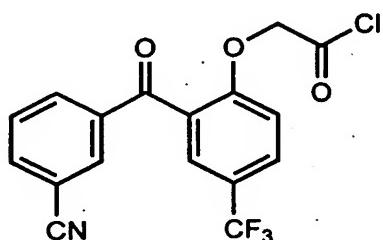
**Step E:**

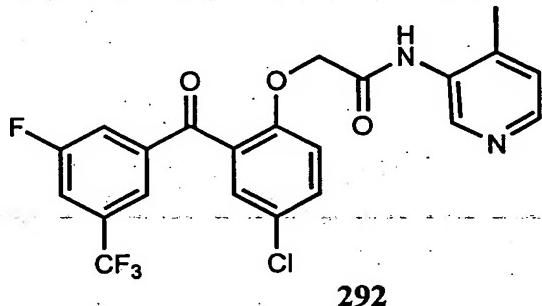
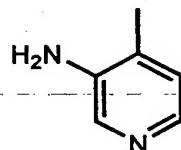
**Step G:****288**

- 5 The title compound (2.196 g, 100%) was prepared according to General Procedure II from the phenol derivative 287 (1.78 g, 5.91 mmol). This intermediate was used without further purification: <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.13 (s, 1 H), 8.09 (d, 1 H), 7.82 (d, 1 H), 7.74 (d, 1 H), 7.73 (s, 1 H), 7.58 (t, 1 H), 6.90 (d, 1 H), 4.58 (s, 2 H), 4.20 (q, 2 H), 1.24 (t, 3 H).

**10 Step H:****289**

- 15 The title compound (1.758 g, 85%) was prepared according to General Procedure III from the ester derivative 288 (2.2 g, 5.91 mmol). This intermediate was used without further purification: <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.18 (s, 1 H), 8.11 (d, 1 H), 7.90 (d, 1 H), 7.78 (dd, 1 H), 7.69 (d, 1 H), 7.64 (t, 1 H), 7.12 (d, 1 H), 4.86 (s, 2 H).



**Example 121****Step A:**

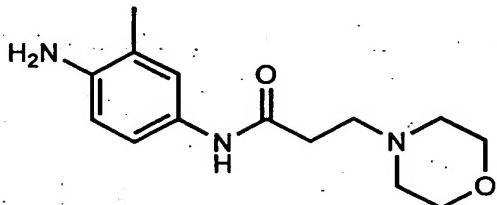
5 A mixture of 4-methyl-3-nitropyridine (1.102 g, 7.24 mmol) and 10% palladium on carbon (0.096 g) in 20 mL of methanol was stirred at room temperature under an atmosphere of 49 psi hydrogen gas for 2 h. The reaction mixture was then filtered through Celite and 10 concentrated *in vacuo* to give 293 (0.849 g, quant.):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.00 (s, 1 H), 7.92 (d, 1 H), 6.93 (d, 1 H), 3.59 (br s, 2 H), 2.14 (s, 3 H).

**Step B:**

15 Compound 292 was prepared according to the General Procedure IV from the acid 71 (0.188 g, 0.5 mmol) and the aminopyridyl derivative 293 (0.065 g, 0.6 mmol). Purification by flash chromatography using 0.5-2% methanol/methylene chloride as eluant gave 292 (0.071 g, 30%) as a white solid: MS (ES+)  $m/z$  467 ( $\text{M}+\text{H}$ ); MS (ES-)  $m/z$  465 ( $\text{M}-\text{H}$ );  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.84 (s, 1 H), 8.65 (s, 1 H), 8.35 (d, 1 H), 7.88 (s, 1 H), 7.70 (d, 1 H), 7.62-7.58 (m, 2 H), 7.40 (d, 1 H), 7.16 (d, 1 H), 7.10 (d, 1 H), 4.76 (s, 2 H), 2.26 (s, 3 H) ppm.

*vacuo*, suspended in ethyl acetate, and filtered. The filtrate was concentrated *in vacuo*, dissolved in ethyl acetate, and allowed to crystallize. The crystalline impurity was removed by filtration, and the filtrate was concentrated *in vacuo* to give 296 (1.767 g, 87%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  11.24 (br s, 1 H), 8.03 (d, 1 H), 7.54 (d, 1 H), 7.43 (dd, 1 H), 3.84-3.82 (m, 4 H), 2.76-2.73 (m, 2 H), 2.64 (br s, 4 H), 2.62 (s, 3 H), 2.58-2.55 (m, 2 H) ppm.

### Step C:



297

A mixture of compound 296 (0.202 g, 0.69 mmol) and 10% palladium on carbon (0.018 g) in 10 mL of methanol was stirred at room temperature under an atmosphere of 53 psi hydrogen gas for 2.17 h. The reaction mixture was then filtered through Celite and concentrated *in vacuo* to give 297 (0.192 g, quant.):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  10.44 (br s, 1 H), 7.38 (s, 1 H), 7.27 (dd, 1 H), 6.76 (s, 1 H), 3.97-3.92 (m, 4 H), 2.91-2.83 (m, 2 H), 2.77-2.72 (m, 4 H), 2.66-2.62 (m, 2 H), 2.25 (s, 3 H).

### Step D:

Compound 294 was prepared according to the General Procedure VI from the acid chloride 49 (0.5 mmol) and the aniline derivative 297 (0.180 g, 0.68 mmol). Purification by flash chromatography using 1-2% methanol/methylene chloride as eluant gave 294 (0.203 g, 71%): MS (ES-)  $m/z$  570 (M-H);  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  10.64 (s, 1 H), 8.27 (s, 1 H), 7.57 (d, 1 H), 7.52-7.48 (m, 2 H), 7.35 (d, 1 H), 7.31-7.30 (m, 2 H), 7.22-7.20, (d, 1 H), 7.04-7.00 (m, 2 H), 4.64 (s, 2 H), 3.77 (br s, 4 H), 2.71-2.68 (m, 2 H), 2.57 (br s, 4 H), 2.50-2.47 (m, 2 H), 2.14 (s, 3 H).

### Example 123

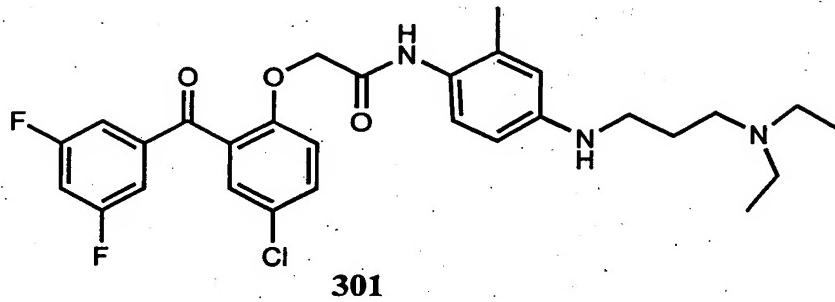
hydrogen gas for 1 h. The reaction mixture was then filtered through Celite and concentrated *in vacuo* to give 300 (0.166 g, 80%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.48 (s, 1 H), 7.07 (s, 1 H), 6.92 (s, 1 H), 6.58 (d, 1 H), 6.40 (d, 1 H), 6.36 (dd, 1 H), 4.08 (t, 2 H), 3.49-3.48 (m, 1 H), 3.26 (br s, 2 H), 3.08-3.05 (m, 2 H), 2.13 (s, 3 H), 2.08-2.02 (m, 2 H).

5

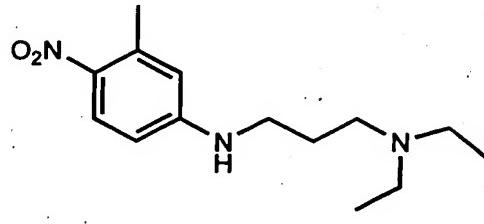
**Step C:**

Compound 298 was prepared according to the General Procedure IV from the acid 49 (0.196 g, 0.6 mmol) and the aniline derivative 300 (0.155 g, 0.67 mmol). Purification by 10 flash chromatography using 2% methanol/methylene chloride as eluant gave 298 (0.219 g, 68%): MS (ES+)  $m/z$  539 ( $\text{M}+\text{H}$ ); MS (ES-)  $m/z$  537 ( $\text{M}-\text{H}$ );  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.08 (s, 1 H), 7.55 (dd, 1 H), 7.49 (s, 1 H), 7.39 (d, 1 H), 7.35-7.31 (m, 2 H), 7.30 (d, 1 H), 7.08 (s, 1 H), 7.06-7.01 (m, 2 H), 6.93 (s, 1 H), 6.43-6.40 (m, 2 H), 4.67 (s, 2 H), 4.09-4.06 (m, 2 H), 3.54 (br s, 1 H), 3.11 (t, 2 H), 2.11-2.06 (m, 5 H).

15

**Example 124**

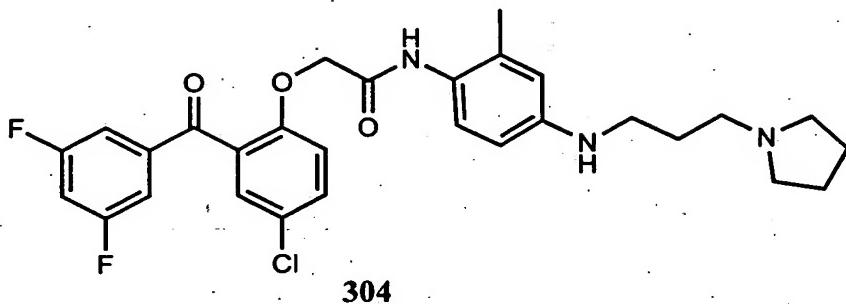
20 **Step A:**



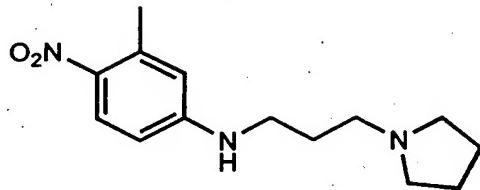
302

s, 1 H); 7.54 (dd, 1 H), 7.39 (d, 1 H), 7.34-7.31 (m, 2 H), 7.25 (d, 1 H), 7.05-6.99 (m, 2 H), 6.43-6.41 (m, 2 H), 4.65 (s, 2 H), 3.15 (t, 2 H), 2.57-2.52 (m, 6 H), 2.07 (s, 3 H), 1.80-1.73 (m, 2 H), 1.05 (t, 6 H).

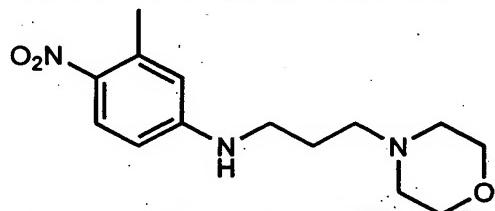
5    **Example 125**



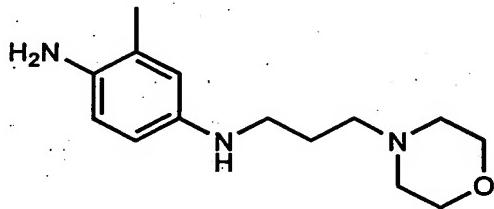
**Step A:**



10    A mixture of 5-fluoro-2-nitrotoluene (0.37 mL, 3.0 mmol), 1-(3-aminopropyl)pyrrolidine (0.64 mL, 5.1 mmol), and sodium bicarbonate (0.454 g, 5.4 mmol) in 7.5 mL of pyridine and 0.75 mL of water was heated to reflux for 3 h. The reaction mixture was stirred at room temperature an additional 3 h, then partitioned between 50 mL of water and 50 mL  
15    of ethyl acetate. The aqueous layer was extracted with an additional 20 mL of ethyl acetate, and the combined organic layers were then dried over  $\text{MgSO}_4$ , filtered, and concentrated *in vacuo* to give 0.758 g of crude material. Purification by flash chromatography using 0.5-10% methanol/methylene chloride as eluant gave 305 (0.595 g, 75%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.06 (d, 1 H), 6.35 (dd, 1 H), 6.29 (d, 1 H), 6.09 (br s, 1 H), 3.30-3.26 (m, 2 H), 2.65-2.62 (m, 2 H), 2.61 (s, 3 H), 2.58-2.52 (m, 4 H), 1.86-  
20    1.78 (m, 6 H).

**Step A:****308**

A mixture of 5-fluoro-2-nitrotoluene (0.24 mL, 2.0 mmol), 4-(3-aminopropyl)morpholine (0.50 mL, 3.4 mmol), and sodium bicarbonate (0.302 g, 3.6 mmol) in 5 mL of pyridine and 0.5 mL of water was heated to reflux for 1 h. The reaction mixture was then partitioned between 50 mL of water and 50 mL of ethyl acetate, and the organic layer was dried over  $\text{MgSO}_4$ , filtered, and concentrated *in vacuo* to give 0.493 g of crude material. Purification by flash chromatography using 1% methanol/methylene chloride as eluant gave 308 (0.279 g, 50%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.06 (d, 1 H), 6.38 (dd, 1 H), 6.31 (s, 1 H), 5.92 (br s, 1 H), 3.77-3.75 (m, 4 H), 3.31-3.27 (m, 2 H), 2.6 (s, 3 H), 2.54-2.50 (m, 6 H), 1.85-1.79 (m, 2 H).

**Step B:****309**

15 A mixture of compound 308 (0.266 g, 0.95 mmol) and 10% palladium on carbon (0.020 g) in 5 mL of methanol was stirred at room temperature under an atmosphere of 60 psi hydrogen gas for 2 h. The reaction mixture was then filtered through Celite and concentrated *in vacuo* to give 309 (0.229 g, 97%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  6.58 (d, 1 H), 6.43 (d, 1 H), 6.39 (dd, 1 H), 3.74-3.72 (m, 4 H), 3.14-3.11 (m, 2 H), 2.48-2.45 (m, 6 H), 2.14 (s, 3 H), 1.81-1.75 (m, 2 H).

**Step C:**

**312**

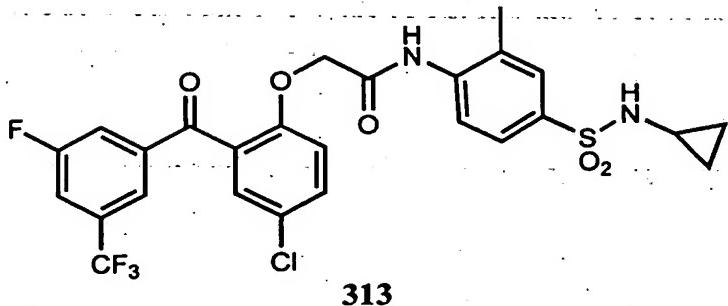
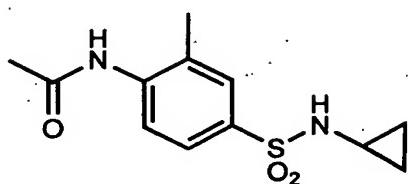
A mixture of compound **311** (0.308 g, 1.2 mmol), 1.5 M HCl (2.5 mL), and ethanol (12 mL) was heated to 80 °C for 18 h, then stirred at room temperature an additional 1 h. The reaction mixture was poured into 50 mL saturated NaHCO<sub>3</sub> (aq) and extracted with two 30-mL portions of methylene chloride. The combined organic layers were dried over MgSO<sub>4</sub>, filtered and concentrated *in vacuo* to give **312** (0.337 g), which was used without further purification: <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.54 (m, 2 H), 6.68 (d, 1 H), 4.29 (t, 1 H), 4.07 (br s, 2 H), 3.00-2.93 (m, 2 H), 2.18 (s, 3 H), 1.10 (t, 3 H).

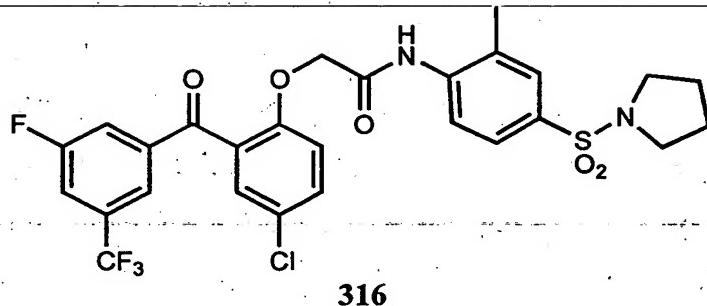
10

**Step C:**

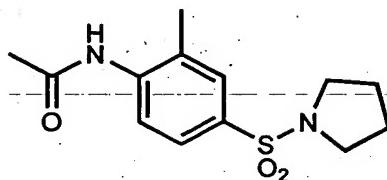
Compound **310** was prepared according to the General Procedure IV from the acid **71** (0.188 g, 0.5 mmol) and the aniline derivative **312** (0.169 g, 0.6 mmol). Purification by flash chromatography using 15-25% ethyl acetate/hexane as eluant gave **310** (0.016 g, 6%): MS (ES+) *m/z* 573 (M+H); MS (ES-) *m/z* 571 (M-H); <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.67 (s, 1 H), 8.08 (d, 1 H), 7.88 (s, 1 H), 7.69 (m, 3 H), 7.59 (dd, 2 H), 7.38 (d, 1 H), 7.09 (d, 1 H), 4.74 (s, 2 H), 3.03-2.95 (m, 2 H), 2.31 (s, 3 H), 1.11 (t, 3 H).

20

**Example 128****Step A:**

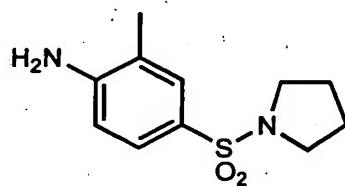
Example 129

## Step A:

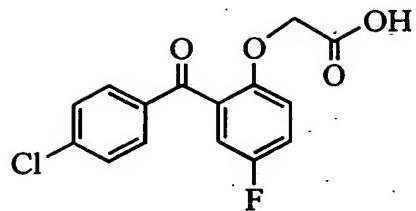


5 A mixture of sulfonyl chloride **464** (1.10 g, 4.4 mmol), pyrrolidine (0.55 mL, 6.6 mmol), and pyridine (0.39 mL, 4.8 mmol) in 50 mL of methylene chloride was stirred at room temperature for 6 d. The reaction mixture was then filtered, and the filter cake was washed with methylene chloride and methanol and dried with a vacuum pump to give **317** (0.696 g, 56%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  9.39 (s, 1 H), 7.82 (d, 1 H), 7.60 (d, 1 H), 7.55 (dd, 1 H), 3.10-3.07 (m, 4 H), 2.28 (s, 3 H), 2.09 (s, 3 H), 1.64-1.58 (m, 4 H).

## Step B:



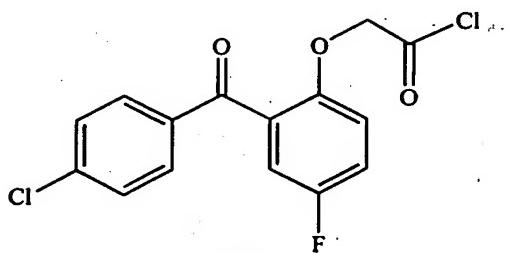
15 A mixture of compound **317** (0.690 g, 2.44 mmol), 1.5 M  $\text{HCl}$  (5.0 mL), and ethanol (25 mL) was heated to 80 °C for 18 h, then stirred at room temperature an additional 7 h. The reaction mixture was filtered to give **318** (0.369 g, 63%):  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.29-7.26 (m, 2 H), 6.64 (d, 1 H), 5.73 (br s, 2 H), 3.01-2.98 (m, 4 H), 2.05 (s, 3 H), 1.60-1.56 (m, 4 H).



322

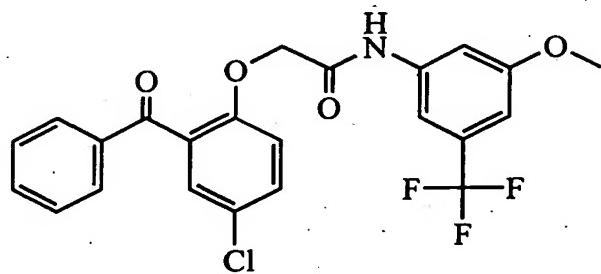
- 5 Ester **321** (6.72 g, 20 mmol), ethanol (80 mL), water (20 mL), and lithium hydroxide monohydrate (1 g, 24 mmol) were used as in general procedure III to afford carboxylic acid **322** as off-white solid (6.56 g, crude material).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  4.7 (s, 2H), 7.1 (d, 1H), 7.3 (d, 1H), 7.4 (m, 1H), 7.6 (d, 2H), 7.8 (d, 2H), 13 (bs, 1H); MS (ES) *m/z* 307 (M-H)<sup>-</sup>.

10



323

- 15 Into a round-bottom flask were placed acid **322** (3 g, 10 mmol) and thionyl chloride (51 mL of a 2N solution in methylene chloride, 102 mmol). After refluxing for 1 1/2 h, the mixture was concentrated in vacuo to give **323** as a dark purple oil, which was used without characterization or purification.

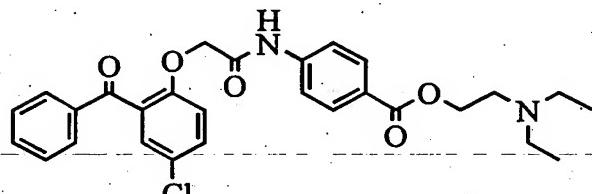
20 Example 130

324

4-Aminophenyl acetonitrile (Aldrich, 0.214 g, 1.62 mmol), NEt<sub>3</sub> (0.23 mL, 1.65 mmol), acetonitrile (5 mL), and acid chloride **320** (0.5 g, 1.62 mmol) in acetonitrile (7 mL) were used as in general procedure X. The product was purified by flash chromatography using 7:3 hexanes:ethyl acetate with 0.01% NEt<sub>3</sub> to afford **326** as an orange solid (0.26 g, 40%).

5     <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 4 (s, 2H), 4.7 (s, 2H), 7.2 (d, 1H), 7.3 (d, 2H), 7.45 (s, 1H), 7.5-7.6 (m, 4H), 7.65 (m, 2H); MS (ES) *m/z* 403 (M-H)<sup>+</sup>.

### Example 133

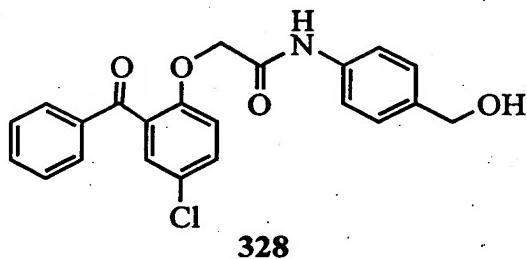


10

Procaine (ICN, 0.382 g, 1.62 mmol), NEt<sub>3</sub> (0.23 mL, 1.65 mmol), acetonitrile (5 mL), and acid chloride **320** (0.38 g, 1.24 mmol) in acetonitrile (5 mL) were used as in general procedure X. The product was purified by flash chromatography using 24:1 methylene chloride:methanol to afford **327** as an off-white solid (0.037 g, 4.5%).

15     <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 1 (t, 6H), 2.8 (bs, 2H), 4.3 (bs, 2H), 4.8 (bs, 2H), 7.2 (d, 1H), 7.5-7.7 (m, 8H), 7.8 (d, 2H), 7.9 (d, 2H), 10.2 (s, 1H); MS (AP<sup>+</sup>) *m/z* 509 (M+H)<sup>+</sup>.

### Example 134



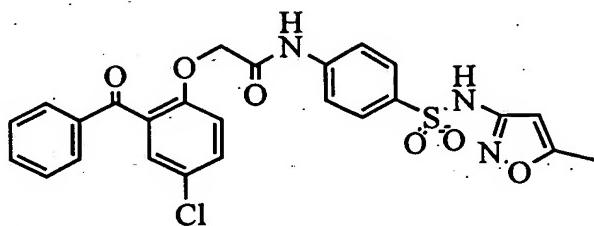
20

4-Amino benzyl alcohol (Fluka, 0.2 g, 1.62 mmol), NEt<sub>3</sub> (0.23 mL, 1.65 mmol), acetonitrile (5 mL), and acid chloride **320** (0.5 g, 1.62 mmol) in acetonitrile (5 mL) were used as in general procedure X. The product was purified by flash chromatography using 4:1 hexanes:ethyl acetate to afford **328** as a dark yellow solid (0.06 g, 10%).

25     <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 4.45 (d, 2H), 4.7 (s, 2H), 5.1 (t, 1H), 7.2 (t, 3H), 7.45 (t, 3H), 7.55 (t, 2H), 7.6 (t, 2H), 7.8 (d, 2H), 9.7 (s, 1H); MS (ES) *m/z* 394 (M-H)<sup>+</sup>.

11%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 400 MHz)  $\delta$  4.7 (s, 2H), 7.15 (dd, 1H), 7.2 (s, 2H), 7.25 (d, 1H), 7.35 (t, 1H), 7.5 (d, 2H), 7.65 (d, 2H), 9.87 (bs, 2H), 10.25 (s, 1H); MS (ES) *m/z* 461 (M-H)<sup>+</sup>.

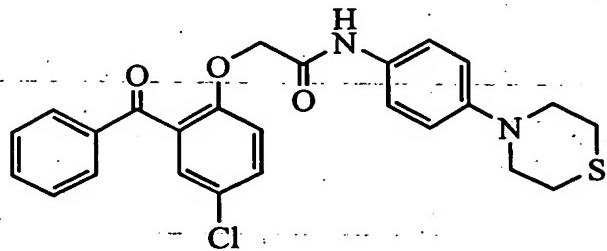
5    **Example 137**



331

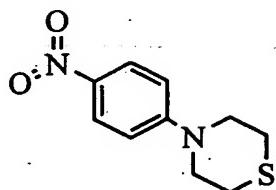
Sulfamethoxazole (Aldrich, 0.424 g, 1.67 mmol), NEt<sub>3</sub> (0.25 mL, 1.79 mmol), acetonitrile (5 mL), and acid chloride 320 (0.52 g, 1.68 mmol) in acetonitrile (5 mL) were used as in general procedure X. The product was purified by flash chromatography using 3:2 hexanes:ethyl acetate as elutant to afford 331 as an off-white solid (0.021 g, 2.4%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 400 MHz)  $\delta$  2.3 (s, 3H), 4.7 (s, 2H), 6.1 (s, 1H), 7.15 (d, 1H), 7.4 (s, 1H), 7.45 (d, 2H), 7.55 (m, 2H), 7.7 (d, 2H), 7.8 (d, 4H), 10.3 (s, 1H), 11.3 (s, 1H); MS (ES) *m/z* 524 (M-H)<sup>+</sup>.

10    **Example 138**

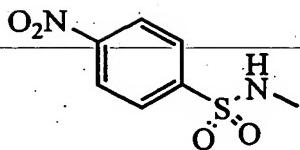


20    332

Step A:

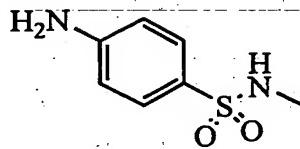


25    333



336

4-Nitrobenzenesulfonylchloride (Aldrich, 44.3 g, 200 mmol) was added portionwise to a solution of methylamine in ethanol (250 mL, 208 mmol) which was stirred at 0 °C under nitrogen. After removing the ice bath, the reaction was stirred for 45 min. Water (250 mL) was added and the resulting product was filtered to afford 336 as a crystalline solid (37.6 g, 87%). The crude material was used without purification.

10 **Step B:**

337

Palladium on carbon (2 g, 10% w/w) was added to a solution of compound 336 (17.3 g, 80 mmol), methanol (80 mL), THF (80 mL), and hydrochloric acid (concentrated, 7 mL, 84 mmol) and used as in general procedure XII to afford 337 as a white solid (14.3 g, 80%). The crude material was used without purification.

**Step C:**

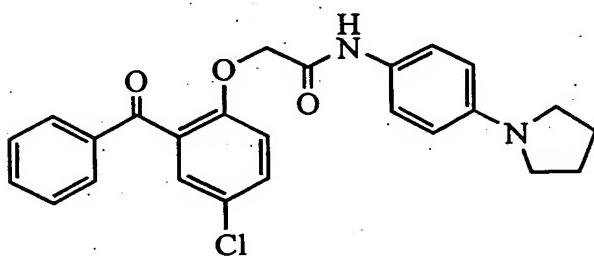
20 Compound 337 (0.32 g, 1.44 mmol), NEt<sub>3</sub> (0.5 mL, 3.6 mmol), acetonitrile (5 mL), and acid chloride 320 (0.444 g, 1.44 mmol) in acetonitrile (5 mL) were used as in general procedure X. After 6 d, another equivalent of acid chloride 320 (0.444 g, 1.44 mmol) was added and the solution was stirred. The reaction mixture was filtered and the resulting solid was washed with acetonitrile and water, and suspended in ethyl acetate. The suspension was filtered and the filtrate concentrated in vacuo to afford 335 as an off-white solid (0.152 g, 23%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.3 (d, 3H), 4.7 (s, 2H), 7.15 (d, 1H), 7.3 (m, 1H), 7.45 (s, 1H), 7.5 (t, 2H), 7.54-7.62 (m, 2H), 7.7 (s, 4H), 7.8 (d, 2H), 10.2 (s, 1H); MS (ES) *m/z* 457 (M-H)<sup>-</sup>.

30 **Example 140**

Compound 340 (0.85 g, 4.6 mmol), NEt<sub>3</sub> (0.87 mL, 6.2 mmol), acetonitrile (8 mL), and acid chloride 320 (1.29 g, 4.2 mmol) in acetonitrile (8 mL) were used as in general procedure X. After 2 d, water was added and the resulting mixture was extracted with ethyl acetate. The organic layer was separated, washed with water, dried over MgSO<sub>4</sub>, and concentrated in vacuo. The product was purified by flash chromatography using 35% ethyl acetate in hexanes to afford 338 as an off-white/ pale yellow solid (0.480 g, 23%).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.95 (s, 3H), 4.7 (s, 2H), 7.15 (d, 2H), 7.2 (d, 1H), 7.45 (d, 3H), 7.7 (m, 7H), 7.85 (d, 2H), 9.6 (s, 1H), 9.8 (s, 1H); MS (ES) *m/z* 457 (M-H)<sup>-</sup>.

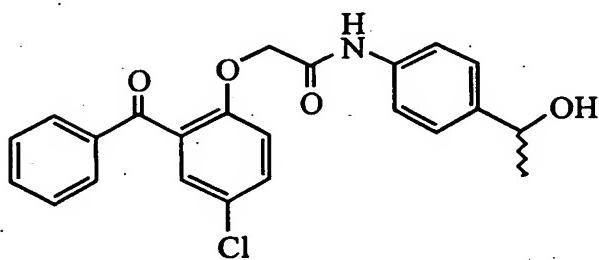
10 **Example 141**



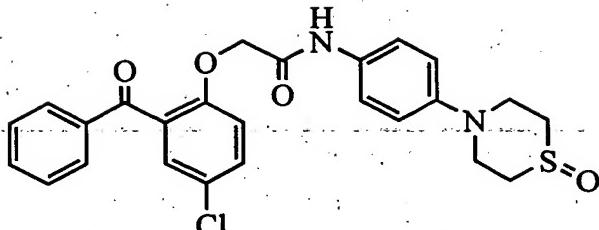
341

4-(N-pyrrolidine)aniline (Apin, 0.262 g, 1.61 mmol), NEt<sub>3</sub> (0.23 mL, 1.65 mmol), acetonitrile (5 mL), and acid chloride 320 (0.5 g, 1.62 mmol) in acetonitrile (5 mL) were used as in general procedure X. The product was purified by flash chromatography using a gradient between 9:1 and 4:1 hexanes:ethyl acetate to afford 341 as an off-white solid (0.112 g, 16%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2 (t, 4H), 3.2 (t, 4H), 4.66 (s, 2H), 6.5 (d, 2H), 7.2 (s, 1H), 7.3 (t, 2H), 7.45 (s, 1H), 7.5 (t, 2H), 7.6 (m, 2H), 7.8 (d, 2H), 9.3 (s, 1H); MS (ES) *m/z* 433 (M-H)<sup>-</sup>.

20 **Example 142**



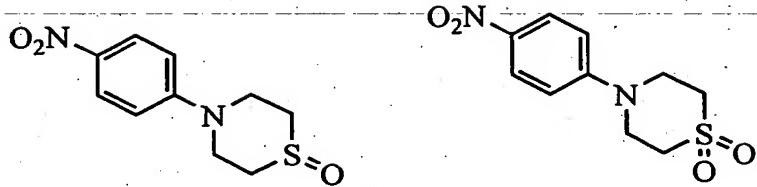
342

**Example 144**

344

**Step A:**

10

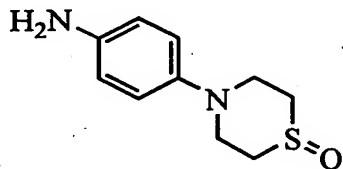


345

346

15 3-Chloroperoxybenzoic acid (~60%, 20.3 g, 70.6 mmol) in methylene chloride was added dropwise to a cooled solution of compound 333 (11.5 g, 51.1 mmol) in methylene chloride (250 mL total reaction volume) and stirred at -78 °C. After 2 h, the reaction was warmed to rt and stirred overnight. The reaction mixture was washed with saturated sodium meta bisulfite, 2N NaOH, and water. The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo to give a mixture of 345 and 346 as a yellow solid (8.47 g, crude material). The crude material was used without purification.

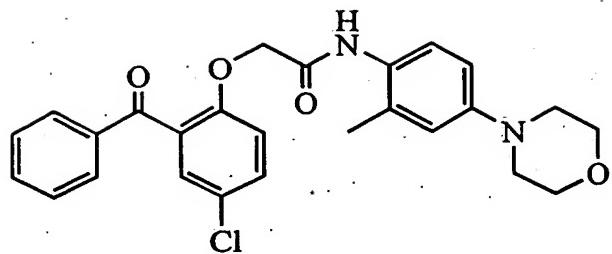
20

**Step B:**

25

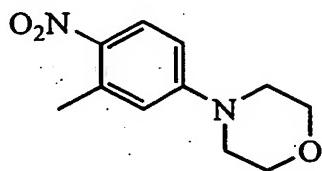
347

The mixture of 345 and 346 (8.47 g, 35.3 mmol), palladium on carbon (1.4 g, 10% w/w), ethanol (100 mL) and THF (50 mL) were used as in general procedure XII using 60 psi of hydrogen. The product was purified by flash chromatography using a gradient between



349

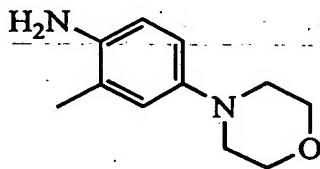
5

**Step A:**

350

- 10 4-Chloro-2-nitrotoluene (SALOR, 2 g, 11.7 mmol) in pyridine (25 mL), sodium bicarbonate (2 g, 23.8 mmol), water (5 mL), and morpholine (Aldrich, 2.03 g, 23.3 mmol) were used as in general procedure XI to afford 350 as a yellow solid (0.804 g, 31%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.5 (s, 3H), 3.4 (t, 4H), 3.7 (t, 4H), 6.9 (d, 2H), 8 (d, 1H). The crude material was used without purification.

15

**Step B:**

351

- 20 Compound 350 (0.72 g, 4.63 mmol), palladium on carbon (0.1 g, 10% w/w), ethanol (20 mL), and THF (20 mL) were used as in general procedure XII using 50 psi of hydrogen to afford 351 as a brown solid (0.623 g, crude material).

**Step C:**

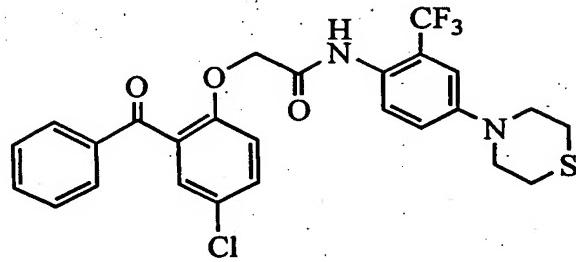
25

Compound 353 (1.62 g, 5.9 mmol), palladium on carbon (0.2 g, 10% w/w), ethanol (12 mL) and THF (12 mL) were used as in general procedure XII using 75 psi of hydrogen to afford 354 as a brown solid (1.41 g, crude material).

Step C:

Compound 354 (1.41 g, 5.73 mmol), NEt<sub>3</sub> (0.8 mL, 5.74 mmol), acetonitrile (15 mL), and acid chloride 320 (1.8 g, 5.82 mmol) in acetonitrile (15 mL) were used as in general procedure X. The product was purified by flash chromatography using 35% ethyl acetate in hexanes and further purified by flash chromatography using 1:1 ethyl acetate:hexanes to afford 352 as an off-white solid (0.426 g, 14%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 3.2 (t, 4H), 3.75 (t, 4H), 4.7 (s, 2H), 7.15 (s, 1H), 7.2 (m, 3H), 7.45-7.55 (m, 3H), 7.6 (t, 2H), 7.8 (d, 2H), 9 (s, 1H); MS (ES) *m/z* 517 (M-H)<sup>+</sup>.

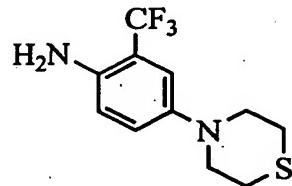
**Example 148**



355

20

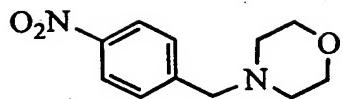
Step A:



356

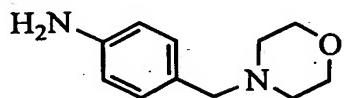
25

5-Bromo-2-nitrobenzotrifluoride (Lancaster, 2 g, 7.4 mmol) in pyridine (20 mL), sodium bicarbonate (1.25 g, 14.9 mmol), water (5 drops), and thiomorpholine (Aldrich, 1.52 g, 14.7 mmol) were used as in general procedure XI to afford 356 as a yellow solid (1.63 g,

**359**

Morpholine (Aldrich, 0.74 mL, 8.5 mmol) was added dropwise to a solution of 4-nitrobenzylbromide (Aldrich, 2 g, 9.26 mmol), in acetone (20 mL), and potassium carbonate (2.4 g, 17.4 mmol). The resulting suspension was stirred at rt for 6 d under nitrogen. The mixture was filtered and the filtrate was concentrated in vacuo to afford **359** as a pale yellow solid (1.89 g, crude material).

**10 Step B:**

**360**

Compound **359** (1.89 g, 4.63 mmol), palladium on carbon (0.325 g, 10% w/w), ethanol (25 mL) and THF (25 mL) were used as in general procedure XII using 50 psi of hydrogen to afford **360** as a brown solid (1.6 g, crude material).

**Step C:**

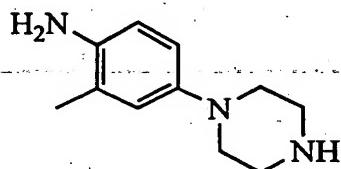
Compound **360** (1.6 g, 8.3 mmol), NEt<sub>3</sub> (0.95 mL, 6.8 mmol), acetonitrile (7 mL), and acid chloride **320** (1.53 g, 4.95 mmol) in acetonitrile (7 mL) were used as in general procedure X. The product was purified by flash chromatography using a gradient between 9:1 and 4:1 hexanes:ethyl acetate **358** as an off-white solid (0.264g, 12%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.35 (d, 4H), 3.41 (s, 3H), 3.57 (t, 4H), 4.73 (s, 2H), 7.23 m, 3H), 7.47-7.67 (m, 7H), 7.83 (d, 2H), 9.78 (s, 1H); MS (ES) *m/z* 463 (M-H)<sup>-</sup>.

**25**

**Example 150 and Example 151**

in vacuo to afford **363** as a yellow solid (4.22 g). MS (ES<sup>+</sup>) *m/z* 222 (M+H)<sup>+</sup>. The crude product was used without purification.

5 Step B:



**364**

Compound **363** (1.88 g, 8.5 mmol), palladium on carbon (0.563 g, 10% w/w), ethanol (35 mL), and THF (35 mL) were used as in general procedure XII to afford **364** as a yellow oil (1.7 g). The crude product was used without purification.

**Step C:**

Compound **364** (1.7 g, 8.9 mmol), NEt<sub>3</sub> (1.4 mL, 10 mmol), acetonitrile (12 mL), and acid chloride **320** (2.36 g, 7.6 mmol) in acetonitrile (12 mL) were used as in general procedure X. Water was added to the reaction mixture and the resulting suspension was filtered.

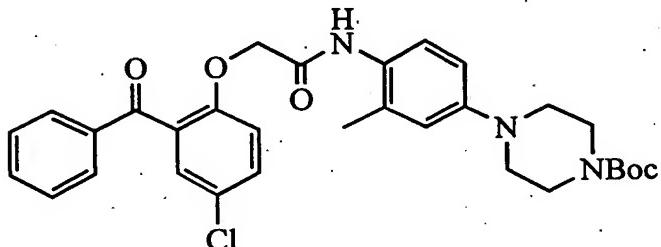
The filtrate was partitioned between 2N NaOH and ethyl acetate. The aqueous layer was acidified with 1N sodium hydrogen sulfate to pH 1 and extracted with ethyl acetate. The product was purified by flash chromatography using a gradient between 3:2 hexanes:ethyl acetate, ethyl acetate, and methanol to afford **362** as a yellow solid (0.250 g) MS (ES<sup>+</sup>) *m/z* 494 (M+H)<sup>+</sup> and **361** as an orange solid (0.005g, 0.1%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.96 (s, 3H), 2.79 (m, 4H), 2.97 (m, 4H), 4.66 (s, 2H), 6.66 (m, 2H), 7.05 (d, 1H), 7.2 (d, 1H), 7.42 (d, 1H), 7.46 (t, 2H), 7.6 (t, 2H), 7.75 (d, 2H), 8.79 (s, 1H); MS (ES<sup>+</sup>) *m/z* 464 (M+H)<sup>+</sup>.

25

**Example 152**

The product was filtered through a celite pad eluted with 9:1 methylene chloride:methanol and concentrated in vacuo to afford 367 as a pink solid (2.926 g, crude material).

**Step C:**



**368**

Acid chloride 320 in methylene chloride was added dropwise to a solution of compound 367 (0.362 g, 1.24 mmol) in pyridine (20 mL) and stirred for 2 days. The reaction was 10 concentrated in vacuo, ethanol and ice were added, and the resulting solid was filtered and washed with ether to afford 368 as a yellow solid (0.118 g, 20.2%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 400 MHz)  $\delta$  1.38 (d, 9H), 1.95 (s, 3H), 3 (d, 4H), 3.4 (s, 4H), 4.67 (s, 2H), 6.7 (m, 2H), 7.1 (d, 1H), 7.42 (d, 1H), 7.48 (m, 2H), 7.6 (m, 2H), 7.75 (d, 2H), 8.8 (s, 1H).

**15 Step D:**

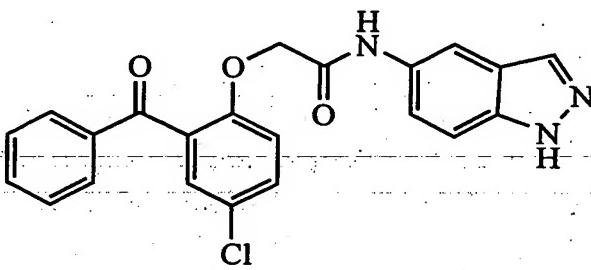
TFA (15 mL, 195 mmol) was added to a solution of compound 368 (0.118 g, 0.21 mmol) in acetonitrile and stirred overnight. The reaction mixture was concentrated in vacuo after carbon tetrachloride was added to azeotrope off the TFA. This procedure was repeated 20 multiple times. The mixture was concentrated in vacuo to afford 365 as a yellow solid (0.085 g, 88%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 400 MHz)  $\delta$  1.96 (s, 3H), 3.08 (d, 4H), 3.17 (d, 4H), 4.67 (s, 2H), 6.72 (m, 2H), 7.1 (d, 1H), 7.2 (d, 1H), 7.42 (s, 1H), 7.46 (m, 2H), 7.6 (m, 2H), 7.75 (d, 2H), 8 (bs, 1H), 8.86 (s, 1H); MS (ES<sup>+</sup>) *m/z* 464 (M+H)<sup>+</sup>.

**Example 153**

4-Nitroaniline (Sigma, 0.244 g, 1.77 mmol), NEt<sub>3</sub> (0.25 mL, 1.79 mmol), acetonitrile (5 mL), and acid chloride 320 (0.54 g, 1.75 mmol) in acetonitrile (5 mL) were used as in general procedure X. The product was purified by flash chromatography using 4:1 hexanes:ethyl acetate to afford 371 as an off-white solid (0.012 g, 2%). <sup>1</sup>H NMR (CDCl<sub>3</sub>, 300 MHz) δ 4.8 (s, 2H), 7.05 (d, 1H), 7.4 (d, 1H), 7.5 (m, 3H), 7.65 (t, 1H), 7.9 (d, 2H), 8 (d, 2H), 8.25 (d, 2H), 10 (s, 1H); MS (ES<sup>+</sup>) *m/z* 409 (M-H)<sup>+</sup>.

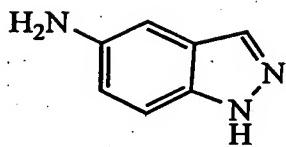
### Example 155

10



### 15 Step A:

20



5-Nitroindazole (Aldrich, 1.2 g, 7.36 mmol), palladium on carbon (0.23 g, 10% w/w), ethanol (25 mL), and THF (5 mL) were used as in general procedure XII using 78 psi of hydrogen to afford 373 as a pink solid (0.98 g, crude material). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 4.7 (s, 2H), 6.7 (dd, 2H), 7.2 (D, 1H), 7.7 (S, 1H), 12.5 (S, 1H).

25

### Step B:

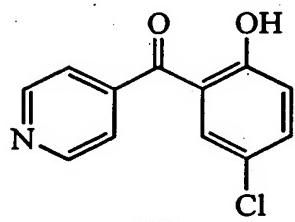
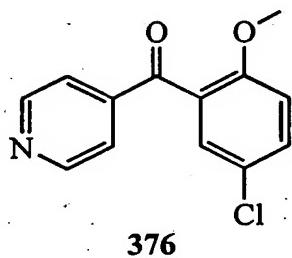
Compound 373 (1 g, 7 mmol), NEt<sub>3</sub> (1.2 mL, 8.6 mmol), acetonitrile (20 mL), and acid chloride 320 (1.9 g, 6.2 mmol) in acetonitrile (10 mL) were used as in general procedure X.

Ice water was added and the resulting suspension was filtered, washed with water, and the solid was recrystallized from ethanol and water. The resulting precipitate was filtered

**375**

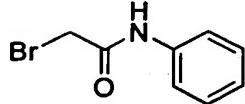
Compound **378** (0.143 g, 0.64 mmol) was added to a solution of compound **377** (0.15 g, 0.64 mmol), potassium carbonate (0.09 g, 0.65 mmol), and DMF (5 mL) and stirred overnight. The mixture was poured into ice water, filtered, and the resulting solid was washed with ether. The product was purified by TLC prep plate using 23:1 methylene chloride:methanol to afford **375** as an orange solid (0.021g, 9%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  4.7 (s, 2H), 7.06 (t, 1H), 7.25 (d, 1H), 7.3 (t, 2H), 7.55 (d, 2H), 7.58 (s, 1H), 7.67 (m, 3H), 8.77 (d, 2H) 9.86 (s, 1H); MS (ES<sup>-</sup>) *m/z* 366 (M-H)<sup>-</sup>.

10



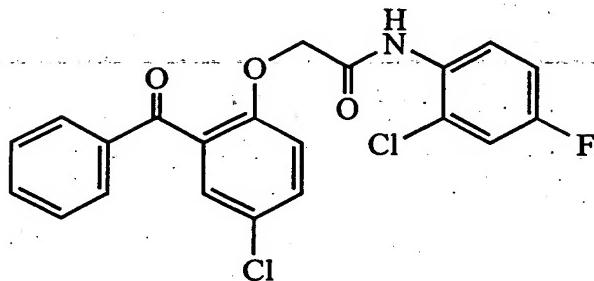
15 Compound **376** (4.2g, 17 mmol) in methylene chloride (100 mL), THF (100 mL), and  $\text{BBr}_3$  (17g, 68 mmol) in methylene chloride (68 mL) were used as in general procedure IX to afford, after recrystallization from methanol, **377** as a yellow solid (1.1g, 28%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  7 (d, 1H), 7.6 (d, 2H), 8.2 (d, 2H), 9.7 (bs, 2H), 10.95 (s, 1H); MS (ES<sup>-</sup>) *m/z* 232 (M-H)<sup>-</sup>.

20

**378**25 **Example 158**

%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 400 MHz)  $\delta$  3.8 (s, 3H), 4.8 (s, 2H), 7.15 (d, 1H), 7.22 (d, 3H), 7.48 (m, 4H), 7.58 (d, 2H), 7.78 (d, 2H), 8.5 (s, 1H), 8.9 (s, 1H); MS (ES $^+$ )  $m/z$  575 (M+H) $^+$ .

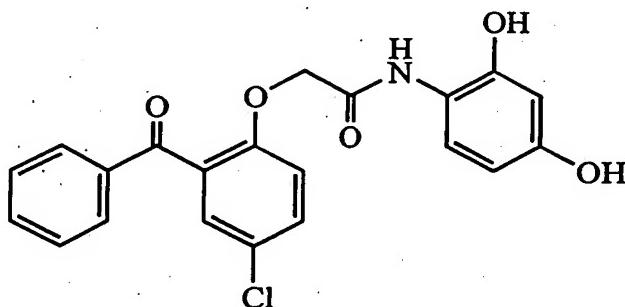
5    **Example 160**



381

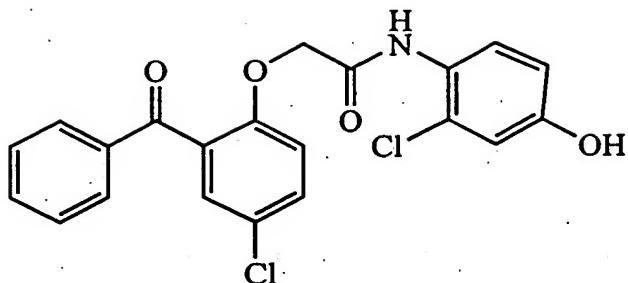
Acid chloride 320 (0.68 g, 2.2 mmol) in methylene chloride (5 mL) was added to a  
10 solution of 2-chloro-4-fluoroaniline (Aldrich, 0.5 g, 3.4 mmol), pyridine (12 mL) and the mixture was stirred overnight. The reaction mixture was poured over ice, ethanol (30 mL) was added, and the precipitate was filtered and washed with 1:1 ethanol:water and diethyl ether to afford 381 as a white solid (0.367 g, 40%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  4.8 (s, 2H), 7.25 (m, 2H), 7.5 (m, 9H), 7.65 (t, 2H), 7.75 (m, 1H), 7.8 (d, 2H), 9.2 (s, 1H); MS (ES $^+$ )  $m/z$  419 (M+H) $^+$ .

15    **Example 161**



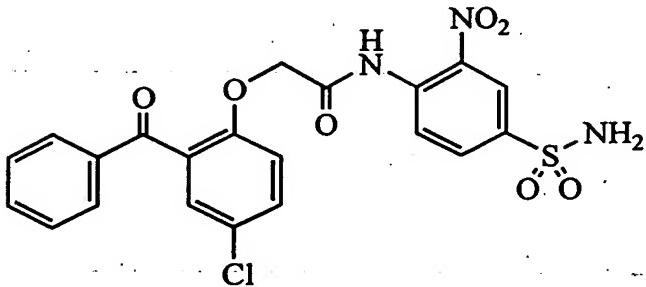
382

Resorcinol hydrochloride (Aldrich, 0.5 g, 3.4 mmol), acetonitrile (20 mL total reaction volume), Et<sub>3</sub>N (0.75 mL, 5.4 mmol), and acid chloride 320 (0.8 g, 2.6 mmol) in acetonitrile were used as in general procedure X. The reaction mixture was poured over  
25 ice water and ethanol was added to the solution. The mixture was recrystallized from

Example 163

385

Carboxylic acid **105** (0.29 g, 1 mmol), HCA (0.08 mL, 0.53 mmol), methylene chloride (5 mL total reaction volume), and  $\text{PPh}_3$  (0.26 g, 1 mmol) were combined in a round-bottom flask under nitrogen at  $-78^\circ\text{C}$ . 4-Amino-3-chlorophenol (Aldrich, 0.145 g, 1 mmol) was free-based by partitioning it between methylene chloride and saturated sodium bicarbonate. The organics were separated, dried over  $\text{MgSO}_4$ , and concentrated in vacuo to give a pink solid that was dissolved in methylene chloride and  $\text{Et}_3\text{N}$  (0.26 mL, 1.9 mmol) and added dropwise to the reaction mixture at  $-78^\circ\text{C}$ . The reaction was warmed to rt and concentrated in vacuo. The product was purified by flash chromatography using 4:1 hexanes:ethyl acetate to afford **385** as an orange solid (0.120 g, 29%).  $^1\text{H NMR}$  ( $\text{DMSO-d}_6$ , 400 MHz)  $\delta$  4.7 (s, 2H), 6.67 (d, 1H), 6.79 (s, 1H), 7.2 (d, 1H), 7.35 (d, 1H), 7.4 (s, 1H), 7.5 (m, 2H), 7.6 (m, 2H), 7.75 (d, 2H), 8.9 (s, 1H), 9.8 (s, 1H);  $\text{MS (ES}^+\text{)} m/z$  417 ( $\text{M+H}^+$ ).

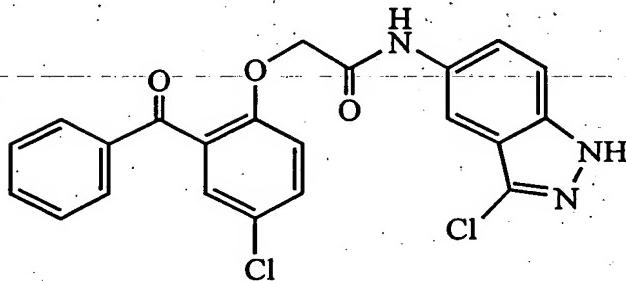
Example 164

386

Carboxylic acid **105** (0.67 g, 2.3 mmol), HCA (0.17 mL, 1.1 mmol), THF,  $\text{PPh}_3$  (0.61 g, 2.3 mmol) in THF, 2-nitro-4-sulfanilamide (0.5 g, 2.3 mmol) in THF (20 mL total reaction volume), and pyridine (2.25 mL, 28 mmol) were used as in general procedure XIII. The reaction mixture was concentrated in vacuo and the product was purified by flash

resulting solution was concentrated in vacuo. The concentrate was purified by flash chromatography using a gradient between 9:1 and 4:1 methylene chloride:methanol as elutant to give an oil. The oil was dissolved in methylene chloride and 1N HCl in Et<sub>2</sub>O (3 mL) was added and the mixture was stored at rt for 7 d. The precipitate was filtered and washed with ether to afford 388 as a yellow orange solid (0.125 g, 10%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 1.8 (m, 2H), 2.28 (s, 6H), 2.5 (m, 2), 4 (t, 2H), 4.8 (s, 2H), 6.9 (d, 1H), 7.08 (d, 1H), 7.25 (d, 1H), 7.45-7.58 (m, 4H), 7.65 (m, 2H), 7.8 (d, 2H), 9.05 (s, 1H); MS (ES<sup>+</sup>) *m/z* 502 (M+H)<sup>+</sup>.

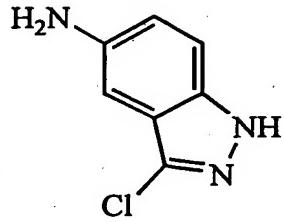
10 **Example 167**



389

15

**Step A:**



390

20 3-Chloro-5-nitroindazole (Lancaster, 5 g, 25 mmol), sodium dithionite (17.6 g, 101 mmol), ethanol (150 mL), and water (50 mL) were combined in a round-bottom flask equipped with a stir bar, reflux condenser, and nitrogen on demand and then refluxed overnight. The reaction mixture was concentrated in vacuo and the resulting solid was dissolved in ethyl acetate, washed with brine and water. The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo to give 390 as a yellow solid (1.3 g, 31%).

The reaction was cooled to rt and the resulting mixture was extracted with ethyl acetate. The organics were dried over MgSO<sub>4</sub> and concentrated in vacuo to give 392 as a white solid (0.394 g, 80%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 6.07 (s, 2H), 6.8 (d, 1H), 7 (s, 2H), 7.39 (dd, 1H), 7.55 (d, 1H); MS (ES) *m/z* 205 (M-H)<sup>-</sup>.

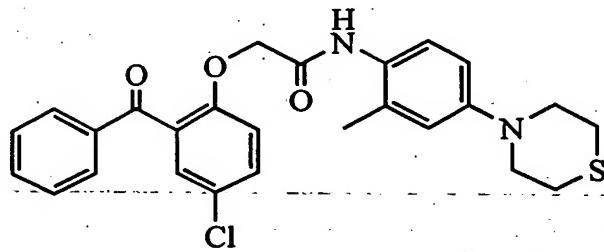
5

### Step B:

Carboxylic acid 105 (0.54 g, 1.9 mmol), HCA (0.14 mL, 0.92 mmol), THF, PPh<sub>3</sub> (0.49 g, 1.9 mmol) in THF, compound 392 (0.384 g, 1.9 mmol), in THF (40 mL total reaction volume), and pyridine (1.8 mL) were used as in general procedure XIII. The reaction mixture was concentrated and the resulting solid was dissolved in ethanol. Water was added and the precipitate was filtered and washed with 1:1 ethanol:water and ether to afford 391 as a white solid (0.206 g, 23.1%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 4.8 (s, 2H), 7.2 (d, 1H), 7.43 (s, 2H), 7.47 (m, 2H), 7.6 (m, 2H), 7.75 (dd, 3H), 7.8 (d, 1H), 8.05 (d, 1H), 9.3 (s, 1H).

20

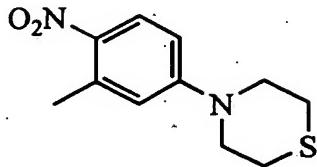
### Example 169



393

25

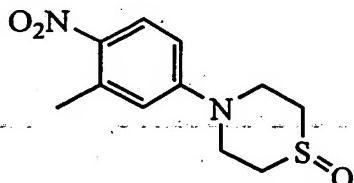
### Step A:



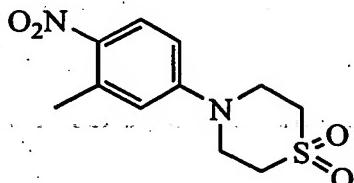
394

5-Fluoro-2-nitrotoluene (Aldrich, 50.6 g, 364 mmol), DMSO (60 mL), and thiomorpholine (37 mL, 368 mmol) were combined and heated to 75°C for 2 h and 100°C for 4h under nitrogen. The reaction was cooled to rt. Ether was added to the mixture and the slurry was stirred vigorously. Water was added to the slurry and the resulting solid was filtered.

Step A:



397

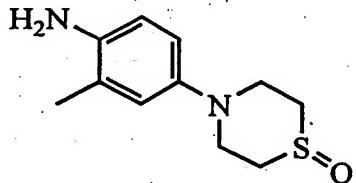


398

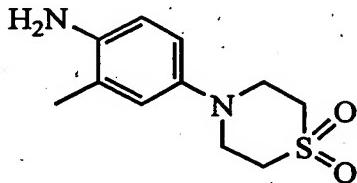
3-chloroperoxybenzoic acid (Aldrich, 0.046 g, 2.7 mmol) in methylene chloride was added dropwise to a stirred solution of compound 394 (12.5 g, 52.4 mmol) in methylene chloride (300 mL total volume for reaction) at -20 °C and the mixture was stirred for 1.5 h after which the cooling bath was removed and the reaction was stirred at rt overnight under nitrogen. The mixture was washed with saturated sodium metabisulfite, 2N NaOH, and water. The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo to give a mixture of 397 and 398 as a yellow solid (12.2 g, crude mixture).

15

Step B:

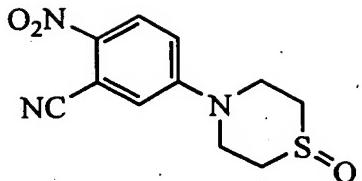


399



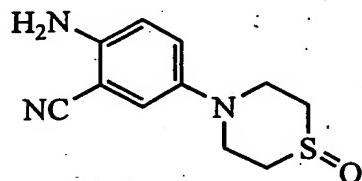
400

The mixture of 397 and 398 (12.3 g), palladium on carbon (3.7 g, 10% w/w), ethanol (100 mL), THF (30 mL), and methanol (75 mL) were used as in general procedure XII using 60 psi of hydrogen to afford an oil. The product was purified on silica gel by flash chromatography using 7:3 hexanes:ethyl acetate, 100% ethyl acetate, and 4:1 ethyl acetate:methanol as elutants to afford 399 as an orange solid (4.27 g, 39%) <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.99 (s, 3H), 2.68 (d, 2H), 2.87 (t, 2H), 3.15 (dd, 2H), 3.44 (t, 2H), 4.38 (bs, 2H), 6.49 (d, 1H), 6.59 (d, 1H), 6.64 (s, 1H); MS (ES<sup>+</sup>) m/z 225 (M+H)<sup>+</sup> and 400 as a tan solid (3.57 g, 31%) <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.99 (s, 3H), 3.08 (m,

**Step B:**

403

- 5     3-Chloroperoxybenzoic acid (Aldrich, 4.85 g, 17 mmol) in methylene chloride was added to a cooled solution of compound 402 (3 g, 12 mmol) in methylene chloride (100 mL total volume for reaction) at -20°C and the mixture was stirred for 15 min. after which the cooling bath was removed and the mixture was stirred at rt for 4 h under nitrogen. The reaction mixture was washed with saturated sodium metabisulfite, 2N NaOH, and brine.
- 10    The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo to afford 403 as a yellow solid (0.59 g, crude material). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.63 (m, 4H), 3.9 (m, 4H), 7.2 (dd, 1H), 7.5 (d, 1H), 8.1 (d, 1H).



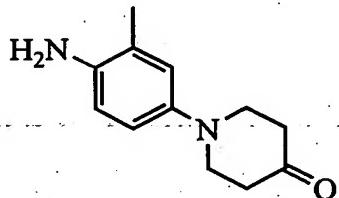
404

- 15    Palladium on carbon (0.23 g, 10% w/w), compound 403 (0.5 g, 1.9 mmol), ethanol (30 mL total reaction volume), THF (20 mL), and methanol (20 mL) were used as in general procedure XII to afford 404 as a green oil (0.41 g, 93%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.68 (d, 2H), 2.9 (t, 2H), 3.3 (d, 2H), 3.55 (t, 2H), 5.6 (bs, 2H), 6.79 (d, 1H), 7.02 (d, 1H), 7.17 (dd, 1H).

**Step C:**

25

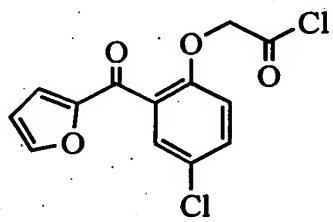
Compound 404 (0.41 g, 1.8 mmol), HCA (0.132 mL, 0.87 mmol), PPh<sub>3</sub> (0.46 g, 1.75 mmol), pyridine (1.7 mL, 21 mmol), THF (25 mL), and carboxylic acid 105 (0.51 g, 1.8 mmol) were used as in general procedure XIII. The concentrate was purified by flash

**Step B:****407**

Compound **406** (0.57 g, 2.4 mmol), palladium on carbon (0.17 g, 10% w/w), ethanol (25 mL) and THF (25 mL) were used as in general procedure XII using 70 psi hydrogen to afford **407** as a yellow oil (0.5 g, crude material).

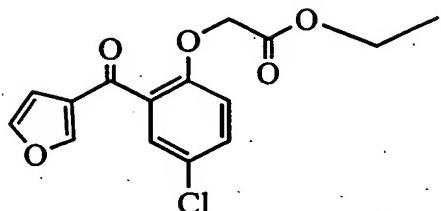
**Step C:**

Compound **407** (0.5 g, 2.1 mmol), HCA (0.16 mL, 1.05 mmol), PPh<sub>3</sub> (0.56 g, 2.1 mmol), pyridine (2 mL, 25 mmol), THF (50 mL), and carboxylic acid **105** (0.62 g, 2.1 mmol) were used as in general procedure XIII. The mixture was concentrated in vacuo and purified on by flash chromatography using a gradient between 1:1 hexanes:ethyl acetate and 100% ethyl acetate as elutant to afford **405** as a yellow solid (0.32 g, 31%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2 (s, 3H), 2.4 (m, 4H), 3.58 (m, 4H), 4.7 (s, 2H), 6.85 (d, 1H), 6.9 (s, 1H), 7.15 (d, 1H), 7.25 (d, 1H), 7.48 (s, 1H), 7.55 (t, 2H), 7.65 (t, 2H), 7.8 (d, 2H), 8.85 (s, 1H); MS (ES<sup>+</sup>) *m/z* 478 (M+H)<sup>+</sup>.

**408**

Carboxylic acid **115** (1 g, 3.6 mmol), methylene chloride (30 mL), and thionyl chloride (7.6 mL, 104 mmol) were used as in general procedure XV to afford **408** as a purple oil (1.24 g, crude material).

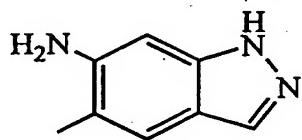
(DMSO-d<sub>6</sub>, 400 MHz) δ 6.8 (s, 1H), 6.95 (d, 1H), 7.4 (m, 2H), 7.8 (s, 1H), 8.25 (s, 1H), 10.45 (s, 1H).



5

**412**

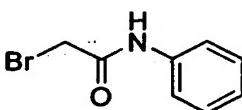
Phenol **411** (12.3 g, 55.3 mmol), potassium carbonate (38.21 g, 277 mmol), ethyl bromoacetate (6.4 mL, 57.7 mmol), and acetone (250 mL) were used as in general procedure II to afford **412** as a yellow/orange foam (15.9 g, 93%). MS (ES<sup>-</sup>) *m/z* 279 (M-H)<sup>-</sup>. The crude product was used without purification.



15

**413**

Compound **415** (0.4 g, 2.3 mmol), palladium on carbon (0.12 g, 10% w/w), and ethanol (50 mL) were used as in general procedure XII using 60 psi of hydrogen to afford **413** as a tan solid (0.35 g, crude material). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.05 (s, 3H), 4.96 (bs, 2H), 6.56 (s, 1H), 7.22 (s, 1H), 7.63 (s, 1H), 12.16 (s, 1H); MS (ES<sup>-</sup>) *m/z* 148 (M-H)<sup>-</sup>.

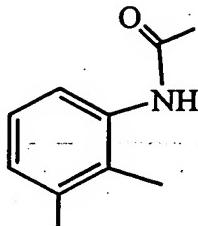


25

**414**

Potassium nitrate (10.13 mL, 100 mmol) in concentrated sulfuric acid (50 mL) was added dropwise to a stirred solution of concentrated sulfuric acid (50 mL) and 2,4-dimethylaniline (Aldrich, 4.94 g, 40.8 mmol) at 0 °C. The reaction was stirred for 3 h. The mixture was poured into ice water (1800 mL) and extracted with ethyl acetate. The organics were separated and concentrated in vacuo to afford **414** as an orange solid (2.98

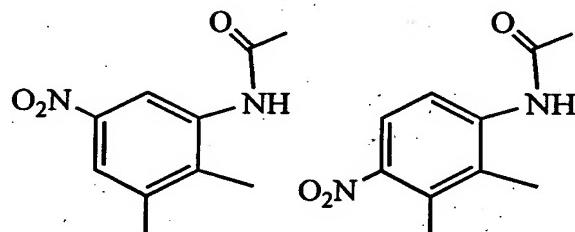
3H), 4.5 (s, 2H), 6.8 (d, 1H), 7.1 (d, 1H), 7.85 (s, 1H), 12.55 (bs, 1H). MS (ES)  $m/z$  148 (M-H)<sup>-</sup>.



5

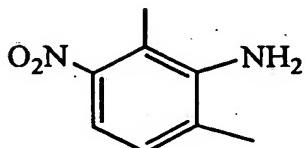
**417**

Acetic anhydride (25 mL, 265 mmol) was added to a stirred solution of 2,3-dimethylaniline (Aldrich, 31.2 g, 257 mmol) and toluene (50 mL) under nitrogen. The resulting solid was filtered and washed with hexanes and ether to afford **417** as a white solid (40.59 g, crude material). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.06 (d, 6H), 2.26 (s, 3H), 7.05 (m, 2H), 7.15 (d, 1H), 9.35 (bs, 1H).

**418**

Potassium nitrate (6.2 g, 61 mmol) in concentrated sulfuric acid (75 mL) was added dropwise over 1 h to a cooled, stirred solution of concentrated sulfuric acid (50 mL) and compound **417** (10 g, 61 mmol) at -17 °C. The cooling bath was removed and the reaction was stirred at 0 °C for 1 h. The solution was poured into ice water (2000 mL) and stirred vigorously. The solution was extracted with methylene chloride. The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo to afford a solid. The solid was purified by flash chromatography using a gradient between 7:3 hexanes:ethyl acetate and ethyl acetate as elutant to afford **418** as a yellow solid (4.24g, 33%). MS (ES)  $m/z$  201 (M-H)<sup>-</sup>. Compound **418** was used as a mixture without purification.

afford **421** as a tan solid (1.43 g, 63.8%). The crude material was used without purification.

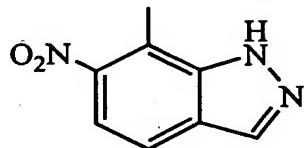


5

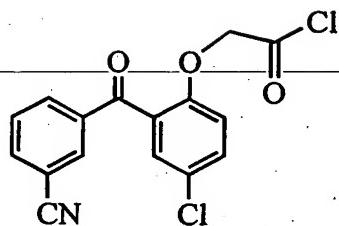
**422**

Potassium nitrate (10.13 mL, 100 mmol) in concentrated sulfuric acid (50 mL) was added dropwise to a stirred solution of concentrated sulfuric acid (50 mL) and 2,6-dimethylaniline (Aldrich, 12.32 g, 100 mmol) at -10 °C and stirred for 1 h. The mixture was poured into ice water and extracted with ethyl acetate. The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo to afford **422** as an orange solid (5.63 g, 34%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.05 (d, 6H), 5.4 (bs, 2H), 6.9 (d, 1H), 6.96 (d, 2H). The crude material was used without purification.

15.

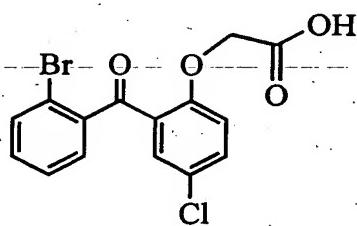
**423**

Sodium nitrite (2.34 g, 34 mmol) in water (10 mL) was added dropwise to a stirred solution of compound **422** (5.63 g, 34 mmol) and glacial acetic acid (500 mL) at 0°C and stirred for 15 min. The cooling bath was removed and the reaction was stored at rt for 6 d. The mixture was concentrated in vacuo and the concentrate was triturated with water. The resulting solid was filtered and recrystallized from methanol to give **423** as a red solid (2.69 g, 45%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.73 (s, 3H), 3.15 (s, 3H), 7.64 (d, 1H), 7.9 (d, 1H), 8.24 (s, 1H), 13.85 (bs, 1H). MS (ES) *m/z* 176 (M-H). The crude material was used without purification.



427

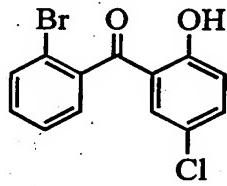
Carboxylic acid **129** (1.5 g, 4.8 mmol), methylene chloride (30 mL), and thionyl chloride (10 mL, 137 mmol) were used as in general procedure XV to afford **427** as an off-white, sticky solid (1.58 g, crude material).



428

Ester **430** (17.24 g, 43 mmol), ethanol (200 mL), water (50 mL), and lithium hydroxide monohydrate (2.27 g, 54 mmol) were used as in general procedure III to afford **123** as a white solid (6.53 g, 41%).

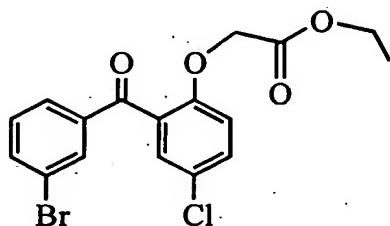
15



429

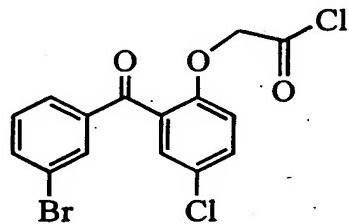
2-Bromobenzoyl chloride (10 g, 46 mmol), aluminum chloride ( $\text{AlCl}_3$ , 6.2 g, 46 mmol),  $\text{CH}_2\text{Cl}_2$  (250 mL), and 4-chloroanisole (5.6 mL, 46 mmol) were used as in general procedure I to afford **429** as a tan solid (13.76 g, crude material).

general procedure I to afford, after triturating the concentrate with hexanes and filtering, 432 as a green solid (25.57 g, 75%). The crude material was used without purification.



433

Compound 432 (9.08 g, 29 mmol), potassium carbonate (20.14 g, 146 mmol), ethyl bromoacetate (3.39 mL, 31 mmol), and acetone (200 mL) were used as in general procedure II to afford 433 as a red/brown oil (12.68 g, crude material). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.12 (t, 3H), 4.06 (q, 2H), 4.75 (s, 2H), 7.11 (d, 1H), 7.44 (t, 2H), 7.54 (d, 1H), 7.69 (d, 1H), 7.83 (d, 2H); MS (ES<sup>+</sup>) *m/z* 398 (M+H)<sup>+</sup>.

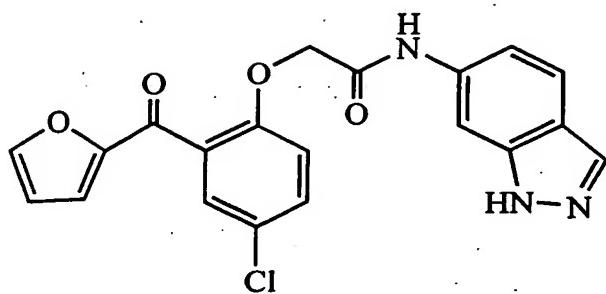


434

Carboxylic acid 431 (3 g, 8.1 mmol), methylene chloride (25 mL), and thionyl chloride (11.84 mL, 162 mmol) were used as in general procedure XV to afford 434 as a light brown oil (2.96 g, 94%). The crude material was used without purification.

20

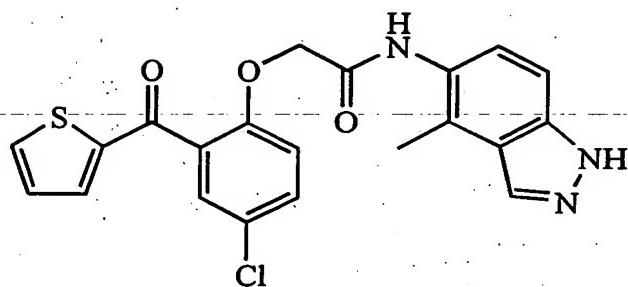
### Example 173



Compound **416** (0.1 g, 0.68 mmol), NEt<sub>3</sub> (0.14 mL, 0.71 mmol), acetonitrile (5 mL total reaction volume), and acid chloride **1** (0.53 g, 1.7 mmol) in acetonitrile were used as in general procedure X. The product was purified by flash chromatography using 1:1 hexanes:ethyl acetate to afford **437** as an off-white solid (0.095 g, 33%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.28 (s, 3H), 4.78 (s, 2H), 7.15 (d, 1H), 7.3 (t, 2H), 7.55 (dd, 3H), 7.65 (t, 2H), 7.82 (d, 2H), 8.13 (s, 1H), 9.18 (s, 1H), 13.04 (bs, 1H); MS (ES<sup>+</sup>) *m/z* 420 (M+H)<sup>+</sup>.

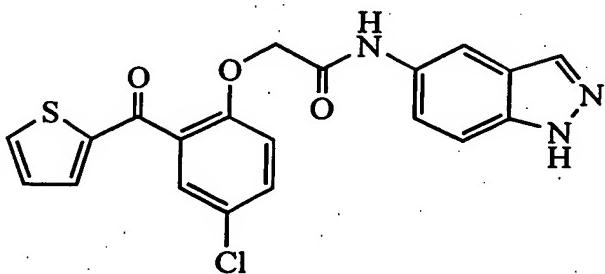
### Example 176

10

**438**

Compound **112** (0.20g, 0.67 mmol), HOBr (0.09 g, 0.68 mmol), DMF (2 mL), compound **416** (0.1 g, 0.68 mmol) in DMF (3 mL), EDAC (0.13 g, 0.69 mmol), and Et<sub>3</sub>N (0.19 mL, 1.36 mmol) were used as in general procedure IV. The product was purified by flash chromatography using 7:3 ethyl acetate:hexanes and 100% ethyl acetate to afford **438** as an off-white solid (0.192 g, 67%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.3 (s, 3H), 4.85 (s, 2H), 7.2-7.35 (m, 4H), 7.55 (s, 1H), 7.65 (d, 1H), 7.7 (s, 1H), 8.15 (s, 2H), 9.38 (s, 1H), 13.05 (s, 1H); MS (ES<sup>+</sup>) *m/z* 424 (M-H)<sup>+</sup>.

### Example 177

**439**

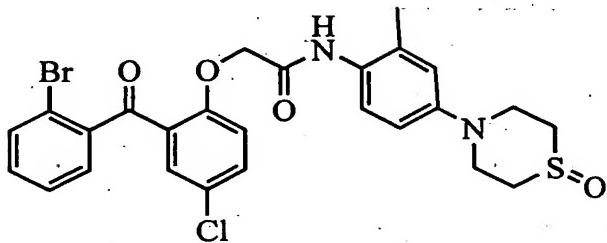
25

Compound 399 (1.2 g, 5.4 mmol) in acetonitrile (45 mL total reaction volume), acid chloride 427 (1.22 g, 3.65 mmol) in acetonitrile, and NEt<sub>3</sub> (0.71 mL, 5.1 mmol) were used as in general procedure X. The product was purified by flash chromatography using 95:5 methylene chloride:methanol as elutant to afford 441 as an off-white solid (0.59 g, 31%).

5      <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.97 (s, 3H), 2.6 (d, 2H), 2.85 (t, 2H), 3.5 (d, 2H), 3.7 (t, 2H), 4.67 (s, 2H), 6.75 (d, 1H), 6.82 (s, 1H), 7.06 (d, 1H), 7.2 (d, 1H), 7.48 (s, 1H), 7.65 (t, 2H), 8.05 (bs, 2H), 8.15 (s, 1H), 8.96 (s, 1H).

### Example 180

10

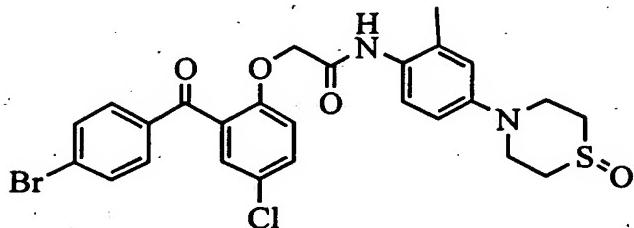


442

Compound 428 (0.443 g, 1.2 mmol), HOBr (0.16 g, 1.2 mmol), DMF, compound 399 (0.40 g, 1.8 mmol) in DMF (15 mL total reaction volume), EDAC (0.23 g, 1.2 mmol), and Et<sub>3</sub>N (0.34 mL, 2.4 mmol) were used as in general procedure IV. The product was purified by flash chromatography using 98:2 methylene chloride:methanol as elutant to afford 442 as an off-white foam (0.154 g, 22%).

15      <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.07 (s, 3H), 2.6 (d, 2H), 2.85 (t, 2H), 3.5 (d, 2H), 3.7 (t, 2H), 4.62 (s, 2H), 6.78 (d, 1H), 6.84 (s, 1H), 7.15 (d, 1H), 7.25 (d, 1H), 7.38 (t, 1H), 7.42 (d, 2H), 7.5 (t, 1H), 7.65 (m, 2H), 8.8 (s, 1H).

### Example 181



443

Compound 424 (0.443 g, 1.2 mmol), HOBr (0.16 g, 1.2 mmol), DMF, compound 399 (0.40 g, 1.8 mmol) in DMF (15 mL total reaction volume), EDAC (0.23 g, 1.2 mmol), and

25

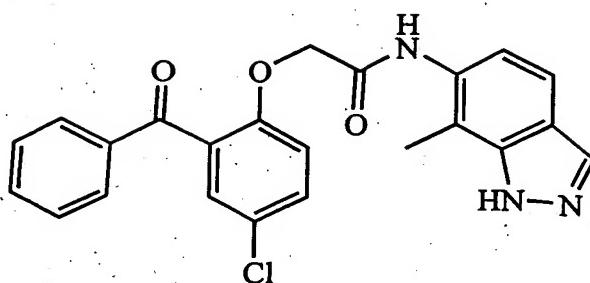
## 445

Copper cyanide (0.037 g, 0.42 mmol) was added to a solution of compound 442 (0.120 g, 0.21 mmol) in DMSO (5 mL) and the reaction was heated to 160 °C and stirred overnight.

- 5 The mixture was cooled and water was added to it. The resulting solid was filtered and washed with ethyl acetate. The filtrate was separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo. The product was purified by flash chromatography using a gradient between 9:1 hexanes:ethyl acetate and ethyl acetate as the elutant to afford 445 as an orange foam (0.012 g, 11%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.99 (s, 3H), 2.62 (d, 2H), 2.86 (t, 2H), 3.5 (d, 2H), 3.69 (t, 2H), 4.62 (s, 2H), 6.75 (d, 1H), 6.82 (s, 1H), 7.05 (d, 1H), 7.2 (d, 1H), 7.55 (d, 1H), 7.7 (m, 4H), 7.98 (d, 1H), 8.97 (s, 1H); MS (ES<sup>+</sup>) *m/z* 521 (M-H)<sup>+</sup>.
- 10

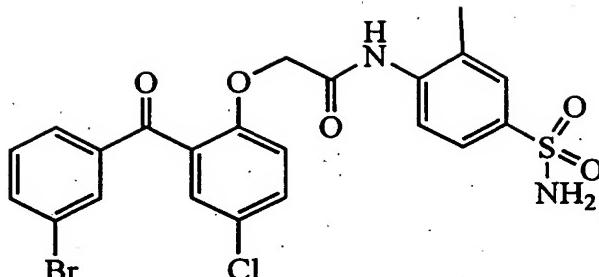
Example 184

15



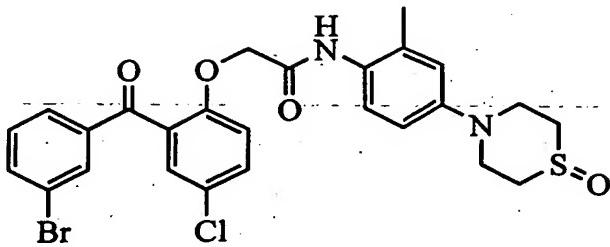
## 446

- 20 Carboxylic acid 105 (0.296 g, 1.2 mmol), HOBr (0.136 g, 1.02 mmol), DMF, compound 421 (0.296 g, 1.02 mmol) in DMF (10 mL total reaction volume), EDAC (0.193 g, 1.02 mmol), and Et<sub>3</sub>N (0.284 mL, 2.04 mmol) were used as in general procedure IV. The product was purified by flash chromatography using 1:1 ethyl acetate:hexanes as elutant. The concentrate was dissolved in methylene chloride, washed with 10% potassium carbonate. The organics were separated, dried over MgSO<sub>4</sub>, and concentrated in vacuo. The resulting solid was triturated with ethyl acetate and filtered to afford 446 as an off-white solid (0.0081 g, 2%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.2 (s, 3H), 4.74 (s, 2H), 6.95 (d, 1H), 7.22 (d, 1H), 7.45 (m, 4H), 7.6 (m, 2H), 7.75 (d, 2H), 7.98 (s, 1H), 9.25 (s, 1H) 13.05 (bs, 1H); MS (ES<sup>+</sup>) *m/z* 420 (M+H)<sup>+</sup>.
- 25

Example 187

449

Compound 466 (0.141 g, 0.757 mmol), NEt<sub>3</sub> (0.106 mL, 0.761 mmol), acetonitrile (20 mL total reaction volume), and acid chloride 434 (0.203 g, 0.523 mmol) were used as in general procedure X. The product was purified by flash chromatography using 98:2 methylene chloride:methanol as elutant to afford 449 as an off-white solid (0.038 g, 14%).  
<sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.14 (s, 3H), 4.77 (s, 2H), 7.22 (m, 3H), 7.45 (dd, 2H), 7.6 (m, 4H), 7.72 (d, 1H), 7.82 (d, 1H), 7.88 (s, 1H), 9.3 (s, 1H); MS (ES) *m/z* 536 (M-H)<sup>-</sup>.

Example 188

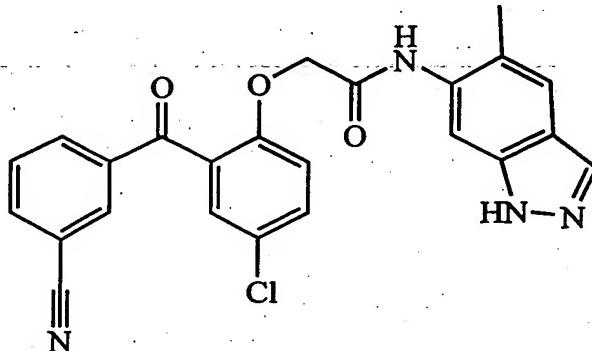
450

20 Compound 399 (1.43 g, 6.37 mmol), NEt<sub>3</sub> (0.888 mL, 6.37 mmol), acetonitrile (50 mL total reaction volume), and acid chloride 434 (1.68 g, 4.64 mmol) were used as in general procedure X. The product was purified by flash chromatography using 98:2 methylene chloride:methanol as elutant to afford 450 as an beige solid (1.3 g, 52%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 1.98 (s, 3H), 2.62 (d, 2H), 2.85 (t, 2H), 3.5 (d, 2H), 3.69 (t, 2H), 4.67 (s, 2H), 6.75 (dd, 1H), 6.82 (d, 1H), 7.08 (d, 1H), 7.2 (d, 1H), 7.42 (d, 1H), 7.46 (d, 1H), 7.62 (dd, 1H), 7.7 (d, 1H), 7.81 (d, 1H), 7.88 (s, 1H), 8.9 (s, 1H); MS (ES) *m/z* 574 (M-H)<sup>-</sup>.

4H), 4.74 (s, 2H), 6.72 (d, 2H), 6.77 (s, 1H), 7.19 (t, 2H), 7.3 (d, 1H), 7.5 (d, 3H), 7.57 (dd, 1H), 8.05 (s, 1H), 9.01 (s, 1H); MS (ES)  $m/z$  553 (M-H).

**Example 191**

5



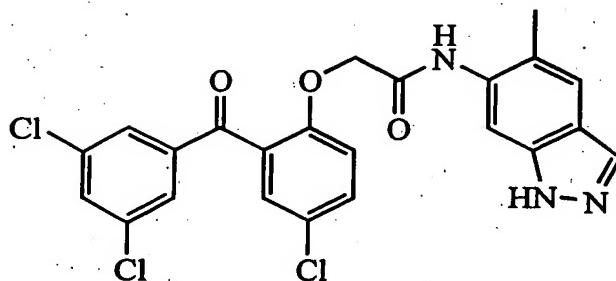
453

Compound 413 (0.072 g, 0.49 mmol) in acetonitrile (10 mL total reaction volume), acid chloride 427 (0.163 g, 0.49 mmol) in acetonitrile, and NEt<sub>3</sub> (0.1 mL, 0.72 mmol) were used as in general procedure X. The product was purified by flash chromatography using 98:2 methylene chloride:methanol as elutant to afford 453 as an off-white solid (0.013 g, 6%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 400 MHz) δ 2.16 (s, 3H), 4.77 (s, 2H), 7.25 (d, 1H), 7.5 (s, 2H), 7.65 (m, 3H), 7.89 (s, 1H), 8.08 (d, 2H), 8.16 (s, 1H), 9.03 (s, 1H), 12.84 (s, 1H); MS (ES)  $m/z$  443 (M-H).

15

**Example 192**

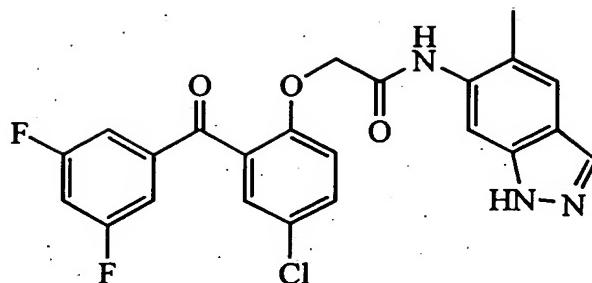
20



454

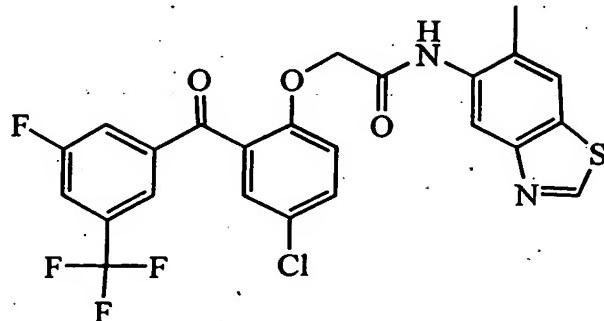
Carboxylic acid 76 (0.2 g, 0.55 mmol), methylene chloride (CH<sub>2</sub>Cl<sub>2</sub>, 3 mL), DMF (4 drops), oxalyl chloride (0.13 mL, 1.49 mmol) were used as in general procedure V. The resulting acid chloride was added to a solution of the amine 413 (0.081 g, 0.55 mmol), acetone (5 mL), sodium bicarbonate (0.42 g, 5 mmol), and water (0.5 mL) as used in

25



Carboxylic acid **49** (0.2 g, 0.6 mmol), methylene chloride (3 mL), DMF (4 drops), oxalyl chloride (0.16 mL, 1.8 mmol) were used as in general procedure V. The resulting acid chloride was then added to a solution of the amine **413** (0.09 g, 0.61 mmol), acetone (10 mL), sodium bicarbonate (0.453 g, 5.4 mmol), and water (0.5 mL) as used in general procedure VI. The reaction mixture was heated to 40 °C for 1 h, after which time water (25 mL) was added to the reaction mixture and the resulting suspension was filtered. The solids were washed with ether to give a gray solid. The product was purified by filtering through a silica gel plug eluted with 9:1 hexanes:ethyl acetate. Hexanes were added to the filtrate until a solid formed. The solid was filtered to afford **456** as a white solid (0.034 g, 12%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>, 300 MHz) δ 2.2 (s, 3H), 4.85 (s, 2H), 7.3 (d, 1H), 7.5 (d, 2H), 7.56 (d, 2H), 7.62(d, 1H), 7.7 (d, 1H), 7.77 (s, 1H), 7.95 (s, 1H), 9.19 (s, 1H), 12.9 (s, 1H); MS (ES) *m/z* 454 (M-H)<sup>-</sup>.

### Example 195



to give an oil. The product was purified by flash chromatography using a gradient between 1:1 hexanes:ethyl acetate and ethyl acetate as elutant to afford **460** as a white solid (0.03g, 8%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 300 MHz)  $\delta$  2.2 (s, 3H), 5.09 (bs, 2H), 7.28 (s, 1H), 7.66 (s, 1H), 9.1 (s, 1H); MS (ES $^+$ ) *m/z* 165 (M+H) $^+$ .

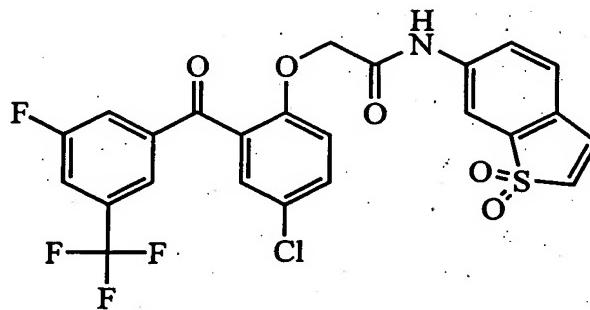
5

#### **Step D:**

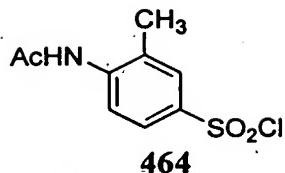
Carboxylic acid **71** (0.091 g, 0.24 mmol), methylene chloride (3 mL), DMF (4 drops), oxalyl chloride (0.057 mL, 0.65 mmol) were used as in general procedure V. The resulting acid chloride was then added to a solution of the amine **460** (0.03 g, 0.18 mmol), acetone (5 mL), sodium bicarbonate (0.18 g, 2.1 mmol), and water (0.5 mL) as used in general procedure VI. The mixture was filtered and the solids were washed with water, ether, and ethyl acetate to afford **457** as an off-white solid (0.064 g, 67%).  $^1\text{H}$  NMR (DMSO-d<sub>6</sub>, 400 MHz)  $\delta$  2.18 (s, 3H), 4.79 (s, 2H), 7.25 (d, 1H), 7.54 (d, 1H), 7.65 (dd, 1H), 7.88 (d, 2H), 7.95 (s, 1H), 7.98 (d, 1H), 8.06 (s, 1H), 9.27 (s, 1H), 9.38 (bs, 1H); MS (ES $^-$ ) *m/z* 521 (M-H) $^-$ .

20

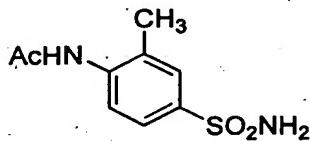
#### **Example 196**

**461**

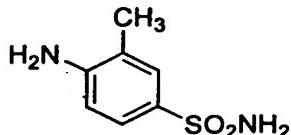
Carboxylic acid **71** (0.091 g, 0.24 mmol), methylene chloride (3 mL), DMF (4 drops), oxalyl chloride (0.057 mL, 0.65 mmol) were used as in general procedure V and added to a solution of 6-amino-1,1-dioxobenzo(b)thiophene (Maybridge, 0.044 g, 0.24 mmol), acetone (10 mL), sodium bicarbonate (0.184 g, 2.2 mmol), and water (1 mL) as used in general procedure VI. The product was purified by filtering through a silica pad eluted with methylene chloride. The organics were washed with saturated sodium bicarbonate, dried over MgSO<sub>4</sub>, and concentrated in vacuo. The product was further purified by flash



Sulfonic acid salt **463** (42.34 g, 169 mmol) and DMF (300 mL) were added to a flask that was equipped with a stir bar and nitrogen on demand and was cooled to 0 °C. Thionyl chloride (30 mL, 411 mmol) was added dropwise from an addition funnel at a rate such that the temperature of the reaction mixture did not exceed 10 °C. When the addition was complete, the mixture was allowed to warm to rt and stir for an additional 2 1/2 h, after which time it was poured into a beaker containing crushed ice. The resulting solid was collected by filtration, washed with several portions of water and dried under vacuum (25.63 g, 61%). <sup>1</sup>H NMR (DMSO, d<sub>6</sub>, 400 MHz) δ 2.02 (s, 3H), 2.15 (s, 3H), 7.33 (s, 2H), 7.38 (s, 1H), 9.27 (s, 1H).

**465**

Into a round-bottom flask, equipped with a stir bar and nitrogen on demand, were placed sodium acetate (19.82 g, 241.6 mmol) and ethyl alcohol (200 mL) and the mixture was cooled to 0 °C. Ammonia gas was bubbled through the sodium acetate solution for 5 min, then sulfonyl chloride **464** (25.63 g, 103 mmol) was added as a solid and in one portion. The resulting mixture was allowed to stir at 0 °C for 30 min, and was then allowed to warm to rt and stir for an additional 18 h. The mixture was then diluted with water and was poured into a separatory funnel containing water and ethyl acetate. The organic layer was collected, washed with water, brine, dried over MgSO<sub>4</sub>, filtered and the solvents were removed under reduced pressure to provide **465** as a yellow solid (8.4 g, 36%), which was used without further purification.



HeLa-CD4-LTR- $\beta$ -gal cells were obtained from the NIH AIDS Research and Reference Reagent Program. Cells were propagated in DMEM containing 10% fetal bovine serum, 0.2 mg/ml geneticin and 0.1 mg/ml hygromycin B. Cells were routinely split by trypsinization when confluence reached 80% (approximately every 2 to 3 days).

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### B. Construction of HIV-1 reverse transcriptase (RT) mutants

DNA encoding the HIV-1 reverse transcriptase was subcloned from a M13 phage into a general shuttle vector, pBCSK+, as a ~1.65 kbp EcoRI/HindIII ended DNA fragment. The HIV DNA insert of the resulting plasmid, pRT2, was completely sequenced on both 10 strands prior to use in site directed mutagenesis experiments. Specific amino acid replacements were made using Stratagene Quick Change reagents and mutagenic oligonucleotides from Oligos. Following mutagenesis, the entire mutant RT coding sequence was verified by sequencing both DNA strands.

15 C. Construction of isogenic HIV-1 RT mutant virus

Mutant HIV-1 strains were isolated by a modified Recombinant Virus Assay (Kellam P. and Larder B., Recombinant virus assay: a rapid, phenotypic assay for assessment of drug susceptibility of human immunodeficiency virus type 1 isolates, 38:23-30, 1994). 1 X 10<sup>7</sup> Jurkat T-cells (maintained in RPMI containing 10% fetal bovine serum, split 1:5 every 20 5 to 6 days) were co-transfected with EcoRI/HindIII digested mutant RT plasmid and Bst EII-digested HIV-1<sub>HXB2ΔRT</sub> DNA in the presence of DMRIE-C transfection reagent (Gibco) according to supplier's recommended protocol. Each mutant RT coding sequence was crossed into the RT-deleted HIV-1 viral DNA backbone by in vivo homologous recombination. Transfected cell cultures were expanded and monitored until syncitia 25 formation and CPE were extensive. Virus was harvested by clear spin of the culture supernatants and frozen at - 80 C as primary stock. Recombinant progeny virus was sequenced in the RT region to confirm the mutant genotype. Virus stocks were further expanded by infection of Jurkat cells, harvested and stored as frozen aliquots. Stocks were titered in HeLa MAGI cells for assay.

30

### D. Titering of virus stocks

Following incubation, the chemiluminescence of each well was measured with a Dynatech plate reader using the following settings:

PARAMETER	VALUE
run	cycle
data	all
gain	low
cycles	1s
pause	2s
rows	abcdefgh
temp	room
stir	off

The output raw data, RLU's, were analyzed by nonlinear regression to determine IC<sub>50</sub> values (see data analysis section below).

#### F. Data Analysis

Relative light units (RLU) are expressed as % control:

$$(RLU \text{ at compound [ ]} / RLU \text{ no compound}) * 100 = \% \text{ Control}$$

The concentration of compound that inhibits 50% of the signal produced in untreated samples (IC<sub>50</sub>) is determined by the following nonlinear regression model available on the ROBOSAGE software package:

$$Y = V_{\max} * (1 - (X^n / (K^n + X^n)))$$

This equation describes a sigmoidal inhibition curve with a zero baseline. X is inhibitor concentration and Y is the response being inhibited. V<sub>max</sub> is the limiting response as X approaches zero. As X increases without bound, Y tends toward its lower limit, zero. K is the IC<sub>50</sub> for the inhibition curve, that is, Y is equal to 50% of V<sub>max</sub> when X = K.

Results in Table 1 are reported as ranges of representative IC<sub>50</sub> values.

### 35 II. MT4 Cell Assay

#### A. Experimental Procedure

Antiviral HIV activity and compound-induced cytotoxicity were measured in parallel by means of a propidium iodide based procedure in the human T-cell lymphotropic virus transformed cell line MT4. Aliquots of the test compounds were serially diluted in

Percent of cells remaining = (compound-treated uninfected cells, rFU / untreated uninfected cells) x 100.

A level of percent of cells remaining of 79% or less indicates a significant level of direct compound-induced cytotoxicity for the compound at that concentration. When this condition occurs the results from the compound-treated infected wells at this concentration are not included in the calculation of IC<sub>50</sub>.

For measurements of compound antiviral activity, results from wells containing various compound concentrations and infected cells are compared to the average of uninfected and infected cells without compound treatment. Percent inhibition of virus is determined by the following formula:

Percent inhibition of virus =  $(1 - ((\text{ave. untreated uninfected cells} - \text{treated infected cells}) / (\text{ave. untreated uninfected cells} - \text{ave. untreated infected cells}))) \times 100$

#### References:

1. Averett, D.R., Anti-HIV compound assessment by two novel high capacity assays, *J. Virol. Methods* 23: 263-276, 1989.
2. Schwartz, O., et al., A rapid and simple colorimetric test for the study of anti-HIV agents, *AIDS Res. and Human Retroviruses* 4 (6): 441-447, 1988..
3. Daluge, S.M., et al., 5-chloro-2'3'-deoxy-3'fluorouridine (935U83), a selective anti-human immunodeficiency virus agent with an improved metabolic and toxicological profile. *Antimicro. Agents and Chemother.* 38 (7): 1590-1603, 1994.
4. Dornfife, R.E., et al., Anti-human immunodeficiency virus synergism by zidovudine (3'-azidothymidine) and didanosine (dideoxyinosine) contrasts with the additive inhibition of normal human marrow progenitor cells, *Antimicro. Agents and Chemother.* 35 (2): 322-328, 1991.

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Results in Table 1. are expressed as representative IC<sub>50</sub> ranges.

**Table 1**

30	Compound Number	Virus Type	IC <sub>50</sub> (nM) Range *	Assay
	1	HIV-1 NEV-R	C D	MT4 MT4

35

	79	HIV-1 HIV-2 NEV-R K103N K103N/Y181C	A D A A A	MT4 MT4 MT4 HeLa HeLa
5	103	HIV-1 NEV-R K103N	B C B	MT4 MT4 HeLa
10	120	HIV-1 NEV-R K103N K103N/Y181C WTRVA Y181C	B B B C B B	MT4 MT4 HeLa HeLa HeLa HeLa
20	122	HIV-1 NEV-R K103N K103N/Y181C WTRVA Y181C	A B B D B C	MT4 MT4 HeLa HeLa HeLa HeLa
25	239	HIV-1 NEV-R E138K G190A G190E K101E K103N K103N/G190A K103N/L1001 K103N/P225H K103N/V1081 K103N/Y181C L1001 P225H P236L V106A V106A/Y181C V1061 V1061/Y181C V1081 V1081/Y181C WTRVA Y181C Y188C	A A A A A A A A B A A A A A B C A A A A A A A A A	MT4 MT4 HeLa
30	257	HIV-1 NEV-R	A A	MT4 MT4
35				
40				
45				
50				
55				

	K103N/Y181C	B	HeLa	
	L1001	A	HeLa	
	P225H	A	HeLa	
5	P236L	B	HeLa	
	V106A	B	HeLa	
	V106A/Y181C	B	HeLa	
	V1061	A	HeLa	
	V1061/Y181C	B	HeLa	
10	V1081	A	HeLa	
	V1081/Y181C	A	HeLa	
	Y181C	A	HeLa	
	Y188C	A	HeLa	
15	453	HIV-1	A	MT4
		NEV-R	A	MT4
		G190A	A	HeLa
		K101E	A	HeLa
		K103N	A	HeLa
		K103N/G190A	B	HeLa
20		K103N/P225H	A	HeLa
		K103N/V1081	A	HeLa
		K103N/Y181C	A	HeLa
		L1001	A	HeLa
		P225H	A	HeLa
25		P236L	B	HeLa
		V106A	C	HeLa
		V106A/Y181C	B	HeLa
		V1061	A	HeLa
		V1061/Y181C	B	HeLa
30		V1081	C	HeLa
		V1081/Y181C	A	HeLa
		WTRVA	A	HeLa
		Y181C	A	HeLa
		Y188C	A	HeLa
35				

\* A indicates an IC<sub>50</sub> of 10nM or less

40 B indicates an IC<sub>50</sub> between 11nM and 100nM

C indicates an IC<sub>50</sub> between 101nM and 1,000nM

D indicates an IC<sub>50</sub> between 1,000nM and 3,000nM

R<sup>3</sup> and R<sup>4</sup> are independently hydrogen; hydroxy; heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, hydroxy, hydroxyC<sub>1-8</sub>alkyl, halogen, C<sub>1-8</sub>alkyl, OR<sup>11</sup> and -SR<sup>10</sup>N(R<sup>10</sup>)<sub>2</sub>; or C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, hydroxyC<sub>1-8</sub>alkyl, -CN, -NO<sub>2</sub>, C<sub>1-8</sub>alkylamino, heterocycleC<sub>1-8</sub>alkyl, -C(O)NH<sub>2</sub>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, -NS(O)<sub>2</sub>R<sup>7</sup>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, -C(O)R<sup>11</sup>, -C(O)NR<sup>11</sup>, -C(O)OR<sup>11</sup>, -NR<sup>11</sup>, -NC(O)R<sup>11</sup>, heterocycleC<sub>2-6</sub>alkenyl, heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo, C<sub>1-8</sub>alkyl, and C(O)OR<sup>11</sup>, and C<sub>1-8</sub>alkyl which may be optionally substituted with one or more substituents selected from the group consisting of -CN and heterocycle, optionally substituted with -C(O)R<sup>11</sup>; provided that R<sup>3</sup> and R<sup>4</sup> cannot both be hydrogen or hydroxy;

R<sup>8</sup> and R<sup>9</sup> are independently selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylamino, C<sub>1-8</sub>alkylheterocycle, heterocycle, and C<sub>3-6</sub>cycloalkyl;

R<sup>10</sup> is C<sub>1-8</sub>alkyl;

R<sup>11</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, and heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo and C<sub>1-8</sub>alkyl;

R<sup>5</sup> is hydrogen; halogen; C<sub>1-8</sub>alkyl; -NO<sub>2</sub>; -NH<sub>2</sub>; C<sub>1-8</sub>alkylamino; CF<sub>3</sub>, or alkoxy; or a pharmaceutically acceptable derivative thereof.

2. A compound of formula (I) according to claim 1 wherein X is O; R<sup>1</sup> is C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, -CN, -SR<sup>6</sup>, -S(O)<sub>2</sub>R<sup>6</sup>; or heterocycle, optionally substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -CN, and C<sub>6-14</sub>arylC<sub>1-8</sub>alkyl; R<sup>6</sup> is C<sub>1-8</sub>alkyl, optionally substituted with halogen; R<sup>7</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy; -NH<sub>2</sub>; or heterocycle; R<sup>2</sup> is hydrogen; R<sup>3</sup> is hydrogen or C<sub>1-8</sub>alkyl; R<sup>4</sup> is heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, halogen, C<sub>1-8</sub>alkyl, -OR<sup>11</sup> and -SR<sup>10</sup>N(R<sup>10</sup>)<sub>2</sub>; or C<sub>6-14</sub>aryl substituted with one or more

-S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, C<sub>2-6</sub>alkenyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, and heterocycle and C<sub>2-6</sub>alkynyl which may be optionally substituted with a substituent selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl, and heterocycle;

5

R<sup>6</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxyl, halogen, -CF<sub>3</sub>, aryl, and heterocycle;

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R<sup>7</sup> is C<sub>1-8</sub> alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, aryl, C<sub>3-6</sub>cycloalkyl and heterocycle; -NH<sub>2</sub>; or heterocycle;

R<sup>2</sup> is hydrogen; halogen; or C<sub>1-8</sub>alkyl;

R<sup>3</sup> is hydrogen;

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R<sup>4</sup> is C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, hydroxyC<sub>1-8</sub>alkyl, -CN, -NO<sub>2</sub>, C<sub>1-8</sub>alkylamino, heterocycleC<sub>1-8</sub>alkyl, -C(O)NH<sub>2</sub>, -S(O)R<sup>7</sup>, -S(O)<sub>2</sub>R<sup>7</sup>, -C(O)R<sup>7</sup>, -NS(O)<sub>2</sub>R<sup>7</sup>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, -C(O)R<sup>11</sup>, -C(O)NR<sup>11</sup>, -C(O)OR<sup>11</sup>, -NR<sup>11</sup>, -NC(O)R<sup>11</sup>, heterocycleC<sub>2-6</sub>alkenyl, heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo, C<sub>1-8</sub>alkyl, and -C(O)OR<sup>11</sup>, and C<sub>1-8</sub>alkyl which may be optionally substituted with one or more substituents selected from the group consisting of -CN and heterocycle, optionally substituted with -C(O)R<sup>11</sup>;

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R<sup>8</sup>and R<sup>9</sup> are independently selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylamino, C<sub>1-8</sub>alkylheterocycle, heterocycle, and C<sub>3-6</sub>cylcoalkyl;

R<sup>11</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, and heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo and C<sub>1-8</sub>alkyl;

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R<sup>5</sup> is hydrogen; halogen; C<sub>1-8</sub>alkyl; -NO<sub>2</sub>; -NH<sub>2</sub>; C<sub>1-8</sub>alkylamino; CF<sub>3</sub>, or alkoxy; or a pharmaceutically acceptable derivative thereof.

$R^7$  is  $C_{1-8}$  alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxyl, halogen, aryl,  $C_{3-6}$ cycloalkyl and heterocycle;  $-NH_2$ ; or heterocycle;

5  $R^2$  is hydrogen; halogen; or  $C_{1-8}$ alkyl;

$R^3$  is hydrogen;

$R^4$  is heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, hydroxy, hydroxy $C_{1-8}$ alkyl, halogen,  $C_{1-8}$ alkyl,  $-OR^{11}$  and  
10  $-SR^{10}N(R^{10})_2$ ;

$R^{10}$  is  $C_{1-8}$ alkyl;

$R^{11}$  is  $C_{1-8}$ alkyl, optionally substituted with one or more substituents selected from the group consisting of hydrogen,  $C_{1-8}$ alkyl,  $-SO_2$ ,  $-S(O)_2NR^8R^9$ , and heterocycle, optionally substituted with one or more substituents selected from the group consisting  
15 of oxo and  $C_{1-8}$ alkyl;

$R^5$  is hydrogen; halogen;  $C_{1-8}$ alkyl;  $-NO_2$ ;  $-NH_2$ ;  $C_{1-8}$ alkylamino;  $CF_3$ , or alkoxy;

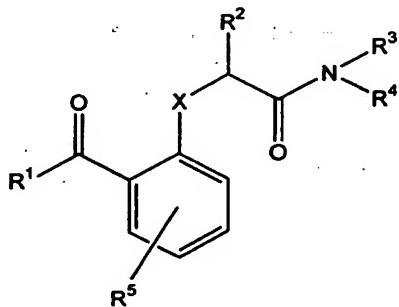
or a pharmaceutically acceptable derivative thereof.

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7. A compound of formula (IB) according to claim 6 wherein X is O;  $R^1$  is  $C_{6-14}$ aryl substituted with one or more substituents selected from the group consisting of halogen,  $-CF_3$ , and  $-CN$ ;  $R^2$  is hydrogen;  $R^3$  is hydrogen;  $R^4$  is heterocycle; and  $R^5$  is halogen; or a pharmaceutically acceptable derivative thereof.

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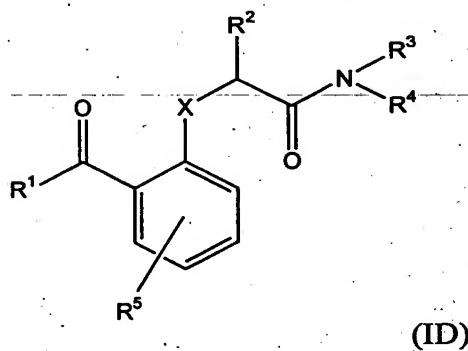
8. A compound of formula (IC):



9. A compound of formula (IC) according to claim 8 wherein X is O; R<sup>1</sup> is heterocycle, optionally substituted with -CN; R<sup>2</sup> and R<sup>3</sup> are hydrogen; R<sup>4</sup> is C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, and heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo; R<sup>5</sup> is halogen; or a pharmaceutically acceptable derivative thereof.

10. A compound of formula (ID):

10



15 wherein:

X is C, O, or N;

R<sup>1</sup> is heterocycle, optionally substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -CN, C<sub>6-14</sub>arylC<sub>1-8</sub>alkyl and heterocycle;

R<sup>2</sup> is hydrogen; halogen; or C<sub>1-8</sub>alkyl;

R<sup>3</sup> and R<sup>4</sup> are independently hydrogen; hydroxy; heterocycle, optionally substituted with one or more substituents selected from the group consisting of oxo, hydroxy, hydroxyC<sub>1-8</sub>alkyl, halogen, C<sub>1-8</sub>alkyl, -OR<sup>11</sup>, and -SR<sup>10</sup>N(R<sup>10</sup>)<sub>2</sub>; or R<sup>3</sup> and R<sup>4</sup> together with the nitrogen atom to which they are attached form a heterocycle which may be optionally substituted with C<sub>6-14</sub>aryl, which may be optionally substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl and -NO<sub>2</sub>; provided that R<sup>3</sup> and R<sup>4</sup> cannot both be hydrogen or hydroxy;

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selected from the group consisting of hydroxy, halogen, aryl, C<sub>3</sub>-cycloalkyl, and heterocycle;

R<sup>6</sup> is C<sub>1</sub>-<sub>8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, -CF<sub>3</sub>, aryl, and heterocycle;

R<sup>7</sup> is C<sub>1</sub>-<sub>8</sub> alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy, halogen, aryl, C<sub>3</sub>-cycloalkyl and heterocycle; -NH<sub>2</sub>; or heterocycle;

R<sup>2</sup> is hydrogen; halogen; or C<sub>1</sub>-<sub>8</sub>alkyl;

R<sup>3</sup> and R<sup>4</sup> form a heterocycle which may be optionally substituted with C<sub>6</sub>-<sub>14</sub>aryl, which may be optionally substituted with one or more substituents selected from the group consisting of C<sub>1</sub>-<sub>8</sub>alkyl and -NO<sub>2</sub>;

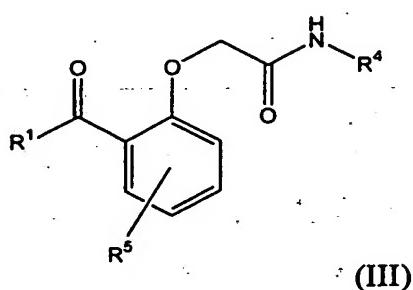
provided that when X is O, and R<sup>1</sup> is unsubstituted C<sub>6</sub>-<sub>14</sub>aryl, then R<sup>3</sup>R<sup>4</sup> is substituted.

R<sup>5</sup> is hydrogen; halogen; C<sub>1</sub>-<sub>8</sub>alkyl; -NO<sub>2</sub>; -NH<sub>2</sub>; C<sub>1</sub>-<sub>8</sub>alkylamino; CF<sub>3</sub>, or alkoxy;

or a pharmaceutically acceptable derivative thereof.

14. A compound of formula (II) according to claim 13 wherein R<sup>1</sup> is C<sub>6</sub>-<sub>14</sub>aryl which is substituted with halogen; R<sup>2</sup> is hydrogen; R<sup>3</sup> and R<sup>4</sup> form a heterocycle which may be optionally substituted with C<sub>6</sub>-<sub>14</sub>aryl, which may be optionally substituted with one or more substituents selected from the group consisting of C<sub>1</sub>-<sub>8</sub>alkyl and -NO<sub>2</sub>; R<sup>5</sup> is halogen; or a pharmaceutically acceptable derivative thereof.

15. A compound of formula (III):



R<sup>10</sup> is C<sub>1-8</sub>alkyl;

R<sup>11</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from

the group consisting of hydrogen, C<sub>1-8</sub>alkyl, -SO<sub>2</sub>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -NR<sup>8</sup>R<sup>9</sup> and

heterocycle, optionally substituted with one or more substituents selected from the

group consisting of oxo and C<sub>1-8</sub>alkyl;

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R<sup>5</sup> is hydrogen; halogen; C<sub>1-8</sub>alkyl; -NO<sub>2</sub>; -NH<sub>2</sub>; C<sub>1-8</sub>alkylamino; CF<sub>3</sub>, or alkoxy;

or a pharmaceutically acceptable derivative thereof,

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provided that:

(a) when R<sup>3</sup> is H and R<sup>4</sup> is C<sub>6-14</sub>aryl substituted with OR<sup>11</sup> wherein R<sup>11</sup> is NR<sup>8</sup>R<sup>9</sup> wherein

R<sup>8</sup> and R<sup>9</sup> are C<sub>1-8</sub>alkyl, and R<sup>1</sup> is C<sub>6-14</sub>aryl, then R<sup>1</sup> cannot be substituted in the para position, and

(b) when R<sup>3</sup> is H and R<sup>4</sup> is unsubstituted C<sub>6-14</sub>aryl, then R<sup>1</sup> cannot be 3-pyridyl or

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cyclopentyl, and

(c) R<sup>1</sup> and R<sup>4</sup> cannot both be unsubstituted.

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16. A compound of formula (III) according to claim 15 wherein R<sup>1</sup> is C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of halogen,

-CF<sub>3</sub>, C<sub>1-8</sub>alkyl, -CN, -SR<sup>6</sup>, -S(O)<sub>2</sub>R<sup>6</sup>; or heterocycle, optionally substituted with one or more substituents selected from the group consisting of C<sub>1-8</sub>alkyl, -CN, and C<sub>6-14</sub>arylC<sub>1-8</sub>alkyl; R<sup>6</sup> is C<sub>1-8</sub>alkyl, optionally substituted with halogen; R<sup>7</sup> is C<sub>1-8</sub>alkyl, optionally substituted with one or more substituents selected from the group consisting of hydroxy; -NH<sub>2</sub>; or heterocycle; R<sup>4</sup> is heterocycle, optionally substituted with one or more

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substituents selected from the group consisting of oxo, halogen, C<sub>1-8</sub>alkyl, -OR<sup>11</sup> and -SR<sup>10</sup>N(R<sup>10</sup>)<sub>2</sub>; or C<sub>6-14</sub>aryl substituted with one or more substituents selected from the group consisting of hydroxy, -CF<sub>3</sub>, C<sub>1-8</sub>alkyl, hydroxyC<sub>1-8</sub>alkyl, -CN, -NO<sub>2</sub>, -C(O)NH<sub>2</sub>, -S(O)<sub>2</sub>R<sup>7</sup>, -S(O)<sub>2</sub>NR<sup>8</sup>R<sup>9</sup>, -OR<sup>11</sup>, -C(O)NR<sup>11</sup>, -C(O)OR<sup>11</sup>, -NR<sup>11</sup>, -NC(O)R<sup>11</sup>, heterocycle which may be optionally substituted with one or more substituents selected from the group consisting of oxo and C<sub>1-8</sub>alkyl; R<sup>8</sup> and R<sup>9</sup> are the same or different and are selected from the group consisting of hydrogen, C<sub>1-8</sub>alkyl, C<sub>1-8</sub>alkylheterocycle, heterocycle, and C<sub>3-6</sub>cycloalkyl;

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- 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1-hydroxyethyl)phenyl]acetamide;
- 2-(2-benzoyl-4-chlorophenoxy)-N-[4-(1-hydroxyethyl)phenyl]acetamide;
- 5 2-(2-benzoyl-4-chlorophenoxy)-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-(2-benzoyl-4-chlorophenoxy)-N-{2-methyl-4-[3-(1-pyrrolidinyl)propoxy]phenyl}acetamide;
- 10 2-(2-benzoyl-4-chlorophenoxy)-N-(1H-indazol-5-yl)acetamide;
- 2-(2-benzoyl-4-chlorophenoxy)-N-{2-methyl-4-[3-(4-morpholinyl)propoxy]phenyl}acetamide;
- 15 2-(2-benzoyl-4-chlorophenoxy)-N-{4-[3-(1H-imidazol-1-yl)propoxy]-2-methylphenyl}acetamide;
- 2-(2-benzoyl-4-chlorophenoxy)-N-(1H-indazol-6-yl)acetamide;
- 20 2-[4-chloro-2-(2-thienylcarbonyl)phenoxy]-N-(1H-indazol-5-yl)acetamide;
- 2-[4-chloro-2-(2-furoyl)phenoxy]-N-(1H-indazol-5-yl)acetamide;
- 25 2-[4-chloro-2-(3-thienylcarbonyl)phenoxy]-N-(1H-indazol-5-yl)acetamide;
- 2-[4-chloro-2-(2-thienylcarbonyl)phenoxy]-N-{2-methyl-4-[3-(4-morpholinyl)propoxy]phenyl}acetamide;
- 30 2-[4-chloro-2-(2-thienylcarbonyl)phenoxy]-N-[4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 2-(2-benzoyl-4-chlorophenoxy)-N-{2-methyl-4-[3-(1-oxo-1lambda~4~,4-thiazinan-4-yl)propoxy]phenyl}acetamide;
- 35 2-[4-chloro-2-(2-furoyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-(2-benzoyl-4-chlorophenoxy)acetamide;
- 40 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(2-thienylcarbonyl)phenoxy]acetamide;
- 2-[2-(1-benzofuran-2-ylcarbonyl)-4-chlorophenoxy]-N-phenylacetamide
- 45 2-[4-chloro-2-(1,3-thiazol-2-ylcarbonyl)phenoxy]-N-phenylacetamide;
- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(2-furoyl)phenoxy]acetamide;

- N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-fluorobenzoyl)phenoxy]acetamide;
- 5 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-chlorobenzoyl)phenoxy]acetamide;
- 10 2-{4-chloro-2-[(4-cyano-2-thienyl)carbonyl]phenoxy}-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 15 2-[4-chloro-2-[3-(trifluoromethyl)benzoyl]phenoxy}-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 20 2-[2-(3-bromobenzoyl)-4-chlorophenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 25 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 30 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[2-(3-bromobenzoyl)-4-chlorophenoxy]acetamide;
- 35 2-[4-chloro-2-(3-methylbenzoyl)phenoxy]-N-[2-methyl-4-(1-oxo-1lambda~4~,4-thiazinan-4-yl)phenyl]acetamide;
- 40 2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]-N-(5-methyl-1H-indazol-6-yl)acetamide;
- 45 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3-pyridinylcarbonyl)phenoxy]acetamide;
- 50 2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]-N-{2-methyl-4-[3-(1-pyrrolidinyl)propoxy]phenyl}acetamide;
- 55 N-[4-(aminosulfonyl)-2-methylphenyl]-2-{4-chloro-2-[(1-methyl-1H-imidazol-2-yl)carbonyl]phenoxy}acetamide;
- 60 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(1,3-thiazol-2-ylcarbonyl)phenoxy]acetamide;
- 65 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-{2-methyl-4-[3-(1-pyrrolidinyl)propoxy]phenyl}acetamide;
- 70 45 N-[4-(aminosulfonyl)-2-methylphenyl]-2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]acetamide;

- N-(1,2-benzisothiazol-5-yl)-2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]acetamide;  
2-[4-chloro-2-(3,5-dichlorobenzoyl)phenoxy]-N-(5-methyl-1H-benzimidazol-6-  
yl)acetamide;
- 5 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-(5-methyl-1H-benzimidazol-6-  
yl)acetamide;
- 10 2-{4-chloro-2-[3-fluoro-5-(trifluoromethyl)benzoyl]phenoxy}-N-(5-methyl-1H-  
benzimidazol-6-yl)acetamide
- 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-1-(2,3-dihydro-1H-indol-1-yl)-1-ethanone;
- 15 2-[4-chloro-2-(3-cyanobenzoyl)phenoxy]-N-[2-methyl-4-  
(methylsulfonyl)phenyl]acetamide;
- 2-[4-chloro-2-(3-ethynylbenzoyl)phenoxy]-N-[2-methyl-4-  
(methylsulfonyl)phenyl]acetamide;
- 20 N-{4-[3-(aminosulfonyl)propoxy]-2-methylphenyl}-2-[4-chloro-2-(3,5-  
difluorobenzoyl)phenoxy]acetamide;
- 2-[2-[3,5-bis(trifluoromethyl)benzoyl]-4-chlorophenoxy]-N-(5-methyl-1H-benzimidazol-  
6-yl)acetamide;
- 25 2-{2-[(5-bromo-3-pyridinyl)carbonyl]-4-chlorophenoxy}-N-(5-methyl-1H-benzimidazol-  
6-yl)acetamide;
- 2-[4-chloro-2-[3-fluoro-5-(trifluoromethyl)benzoyl]phenoxy]-N-(6-methyl-1,3-  
benzothiazol-5-yl)acetamide;
- 30 N-{4-[3-(aminosulfonyl)propoxy]-2-methylphenyl}-2-[4-chloro-2-[3-fluoro-5-  
(trifluoromethyl)benzoyl]phenoxy}acetamide;
- 35 N-[4-(aminosulfonyl)-2-methylphenyl]-2-(4-chloro-2-[3-  
[(trifluoromethyl)sulfonyl]benzoyl]phenoxy)acetamide;
- 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-[4-(1,3-thiazol-2-yl)phenyl]acetamide
- 40 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-[4-(1,3-oxazol-2-yl)phenyl]acetamide
- 2-[4-chloro-2-(3,5-difluorobenzoyl)phenoxy]-N-{4-[(3-hydroxypropyl)sulfonyl]-2-  
methylphenyl}acetamide;
- 45 2-{4-chloro-2-[3-fluoro-5-(trifluoromethyl)benzoyl]phenoxy}-N-(2-methyl-4-  
[(methylamino)sulfonyl]propoxy)phenyl]acetamide;

30. A compound selected from the group consisting of compound number 7, 32, 33, 36,  
38, 44, 45, 49, 51, 52, 61, 65, 66, 71, 75, 76, 111, 112, 115, 118, 119, 128, 129, 171, 172,  
191, 192, 199, 200, 206, 207, 224, 225, 232, 233, 235, 236, 246, 247, 253, 254, 255, 256,  
5 259, 260, 261, 262, 264, 265, 267, 268, 288, 289, 290, 409, 412, 428, 430, 431, and 433.